AVIATION WEEK

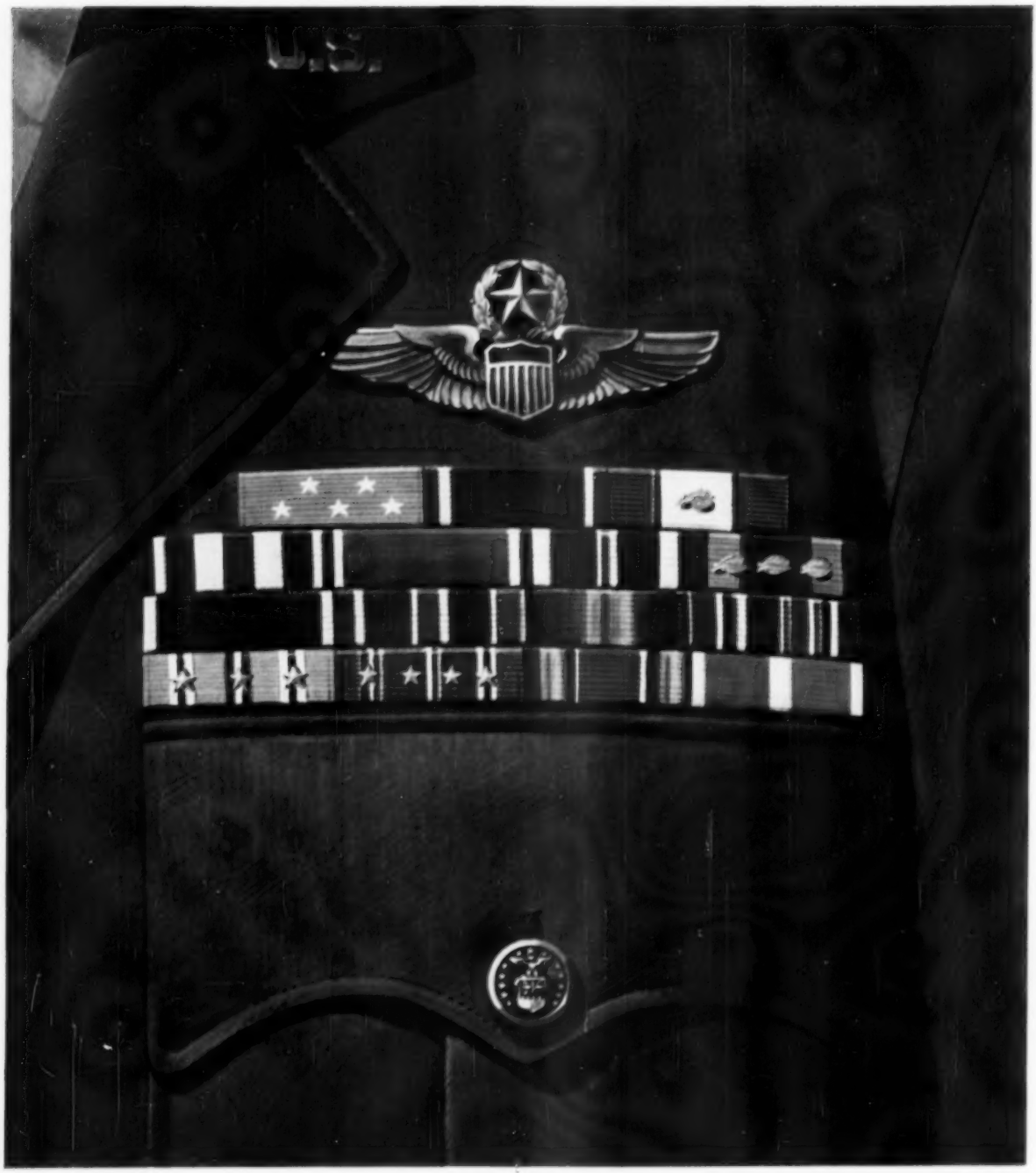
A McGRAW-HILL PUBLICATION

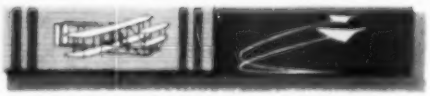
July 29, 1957 50 cents

Orenda Claims Iroquois Engine Weight Stride

Canadair CP-107 Argus

Liquid Oxygen Booms on Weight, Space Saving

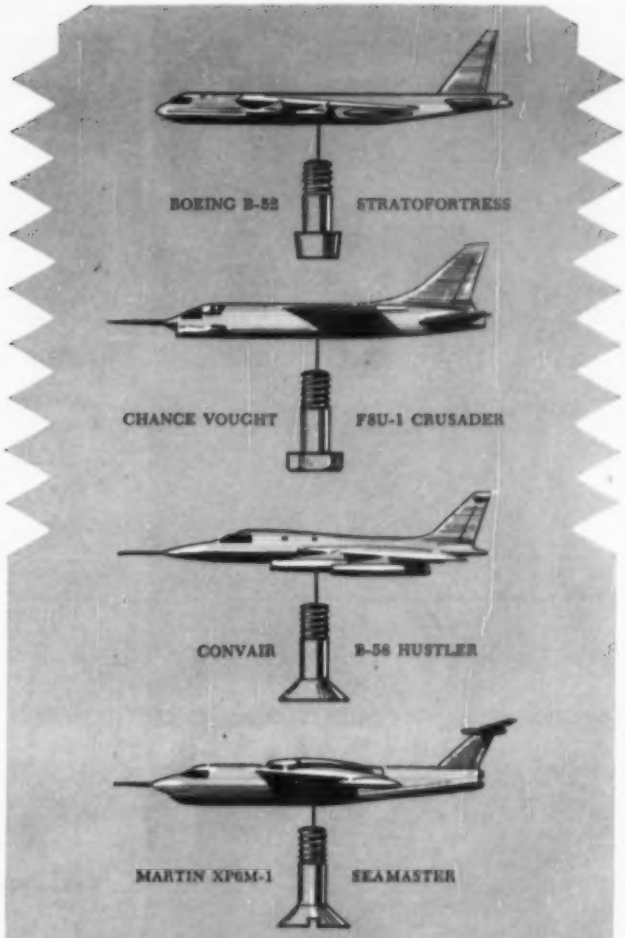


1907  1957

Golden Anniversary of Silver Wings

The United States Air Force through fifty years of leadership in the progress and development of Air Power has become an armed force for peace never exceeded in the history of mankind!

CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION



BASED ON STRENGTH

VOI-SHAN TITANIUM FASTENERS OF GUARANTEED STRENGTH are backed by the thousands of man-hours and dollars that must be invested to develop the skill and the precise conditions necessary to manufacture a titanium bolt, screw, or rivet of the superior requirements for the jet age. Our bid for peace is firmly based on the strength of our air force. Voi-Shan Titanium Fasteners lend strength to many of our present day aircraft, including the B-52, F8U-1, B-58, and XP6M-1.

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A division of PHEOLL MANUFACTURING COMPANY

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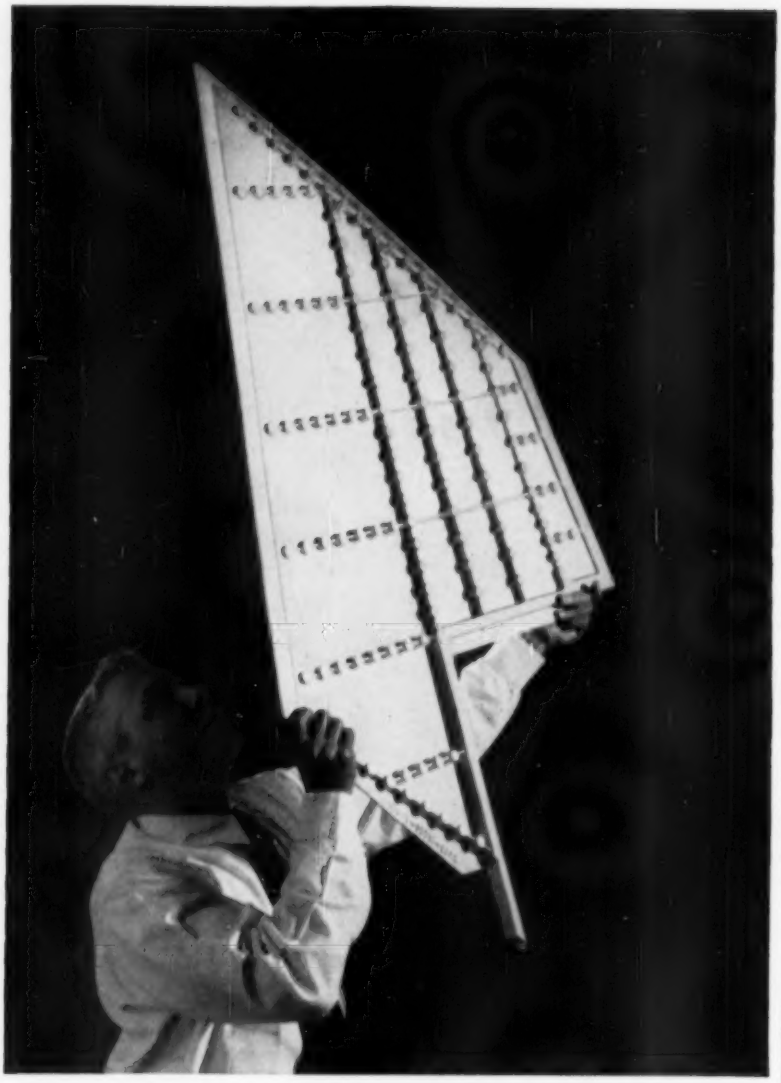

THIN-WALL magnesium casting for the Regulus missile fin produced by Dow.

QUALITY MAGNESIUM CASTINGS

for aircraft and missiles

Sand, Permanent Mold, Plaster Castings

YOU NAME THE CASTING. Dow can supply you with ordinary and extraordinary shapes or sizes. Specialized techniques rigidly maintain your standards and specifications. Heavy-wall or thin-wall, room or elevated temperature use, the best—and surest—answer to your problems is Dow magnesium castings! Contact your nearest Dow sales office for additional information. THE DOW CHEMICAL COMPANY, Foundry Sales, Bay City, Michigan.

YOU CAN DEPEND ON DOW

AVIATION CALENDAR

July 31-Aug. 4—Eleventh Annual National Convention, and Airpower Panorama, Air Force Assn., Sheraton-Park and Shoreham Hotels, Washington, D. C.

Aug. 1-2—Second Annual Exiborama and First Annual National Photo Instrumentation Symposium, Society of Photographic Instrumentation Engineers, Ambassador Hotel, Los Angeles.

Aug. 5-10—National Naval Aviation Meeting, Institute of Aeronautical Sciences, U. S. Grant Hotel, San Diego, Calif.

Aug. 6—Helicopter Transportation in Europe Today and Tomorrow, J. Naome, Sabena Belgian Airlines, Hampton Roads Section Meeting, American Helicopter Society, Langley AFB Officers Club, Va.

Aug. 10-11—Midget Airplane Races, Oshkosh, Wis.

Aug. 17—Open house for pilots and public, Piper Aircraft Corp., Lock Haven, Pa.

Aug. 20-22—Bendix-Scintilla International Ignition Conference, Sidney, N. Y.

Aug. 20-23—Western Electronic Show & Convention, Cow Palace, San Francisco.

Aug. 26-28—Gas Dynamics Symposium Transport Properties in Gases at High Temperatures and Pressures, Technological Institute, Northwestern University, Evanston, Ill.

Aug. 31-Sept. 1—Midget Airplane Races, Ft. Wayne, Ind.

Sept. 1-15—Sixth International Aeronautical Conference, Royal Aeronautical Society and Institute of the Aeronautical Sciences, Folkestone and London, England.

Sept. 2-8—1957 Flying Display, Society of British Aircraft Constructors, Farnborough, England.

Sept. 3-14—11th General Assembly, International Union of Geodesy and Geophysics, in conjunction with International Geophysical Year, University of Toronto, Canada.

Sept. 8-13—Second Annual Course on Investment Castings, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 9-13—Annual General Meeting, Inter-

(*Continued on page 6*)

AVIATION WEEK • JULY 29, 1957

Vol. 67, No. 4

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FROM BRIDE TO BIRDWOMAN

Alys McKey Bryant, one of America's first woman pilots, one-time holder of the woman's altitude record, and an aerial performer of note.

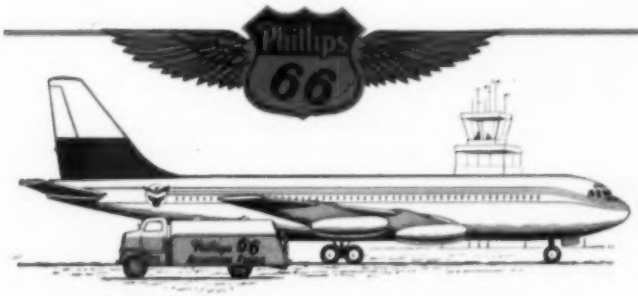
(Photos Courtesy National Air Museum, Smithsonian Institution)

ALYS MCKEY met John Milton Bryant the day she helped pull him from a crashed airplane. In the days that followed, while she called on the young pilot during his recovery, she became more and more interested in flying.

So, in December, 1912, Alys learned to fly. She then married John Bryant and joined him in an aerial flying act, billed as "The Bennett Flyers." The Bryants became one of the most prominent flying teams in the Pacific Northwest, appearing at fairs, carnivals and specially arranged meets.

Mrs. Bryant flew under her maiden name and established a number of records, including the woman's altitude record, and was one of the first women to fly in Canada. John Bryant was a notable flyer of the era, as was his brother Frank, a third member of the troupe.

After her barnstorming days were over, Mrs. Bryant became connected with the Benoist Company, manufacturer of flying boats. During World War I she worked with the Goodyear Company in the development and construction of airships.



A pioneer in research and development of aviation fuels, Phillips Petroleum Company is, today, a foremost supplier of high octane gasoline for commercial, private and military aircraft.

In step with the future, Phillips is a leading producer of *super-performance* Jet Fuels for the latest designs in turbo-props and jets. And Phillips research continues to lead the way for development of fuels for the aircraft of tomorrow.

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  −400F to +2000F
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to meet strictest requirements of

- **TELEMETRY**
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- **AIRCRAFT CONTROL**

an example of

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OPEN TEMPERATURE PICKUPS

The Illustrated OPEN TEMPERATURE PICK-UPS are precision platinum resistance thermometers capable of high-speed temperature measurement of gases and non-corrosive fluids. Resistance winding, supported on ceramic-insulated posts or on card, is in direct contact with environment to be measured, and can have time constants as fast as 50 milliseconds. Full-scale output voltages of 5-volts can be delivered directly to telemetry commutation circuits. Units operate over selected ranges from −820F to +750F (−200C to +400C), with accuracy better than ±1% of full scale and repeatibility of ±0.2%. Calibration Certificate giving precise 5-point calibration supplied with each unit. Stainless steel case and rugged construction withstand 1500 psia pressures, ±25 g vibration, and 60 g shocks under MIL-E-5272A. Send for Technical Bulletins 1182 and 1350.

TRANS-SONICS
INCORPORATED
Burlington, Massachusetts

AVIATION CALENDAR

(*Continued from page 4*)

national Air Transport Assn., Madrid.

Sept. 9-13—Twelfth Annual Instrument Automation Conference & Exhibit, Cleveland Auditorium, Cleveland, Ohio.

Sept. 13—Third Pacific Area National Meeting, American Society for Testing Materials, Sheraton-Palace Hotel, San Francisco, Calif.

Sept. 15—1957 Garden Party and Flying Display, Royal Aeronautical Society, Wisley Aerodrome, Weybridge, England.

Sept. 26-27—Fifth Michigan Aeronautics Conference, jointly sponsored by University of Michigan Transportation Institute, Western Michigan University, and The Aero Club of Michigan, Alpena, Mich.

Sept. 28-29—North Central Regional Conference, Civil Air Patrol, Town House Hotel, Kansas City, Kans.

Sept. 30-Oct. 5—National Aeronautic Meeting, Aircraft Production Forum & Aircraft Engineering Display, Society of Automotive Engineers, Hotel Ambassador, Los Angeles.

Oct. 2-4—Tenth Annual Meeting and Forum, National Business Aircraft Assn., Cosmopolitan Hotel, Denver, Colo.

Oct. 7-9—13th Annual National Electronics Conference, Chicago, Ill.

Oct. 7-10—Triennial Inspection, Lewis Flight Propulsion Laboratory, Cleveland.

Oct. 7-12—Eighth Annual Congress, International Astronautical Federation, Barcelona, Spain. For details write: IAF, 35 Lowell Rd., Concord, Mass.

Oct. 9-11—National Fall Convention, Society for Experimental Stress Analysis, El Cortes Hotel, San Diego, Calif.

Oct. 10-11—National Noise Abatement Symposium, Sherman Hotel, Chicago, Ill.

Oct. 21-22—Canadian Aeronautical Institute-Institute of the Aeronautical Sciences Meeting, Montreal, Canada.

Oct. 21-23—Conference on new developments in the field of power, American Society of Mechanical Engineers, Americus Hotel, Allentown, Pa.

Oct. 24-25—Fourteenth Annual Display, Aircraft Electrical Equipment, Aircraft Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

Oct. 28-31—Second Winter Meeting, American Nuclear Society, Henry Hudson Hotel, N. Y.

Oct. 28-29—Third Annual Meeting, Association of the U.S. Army, Sheraton-Park Hotel, Washington, D. C.

Oct. 28-30—Annual East Coast Conference on Aeronautical and Navigational Electronics, Fifth Regiment Armory, Baltimore, Md.

Oct. 28-31—National Industrial Packaging & Handling Exposition, Atlantic City, Convention Hall, N. J.

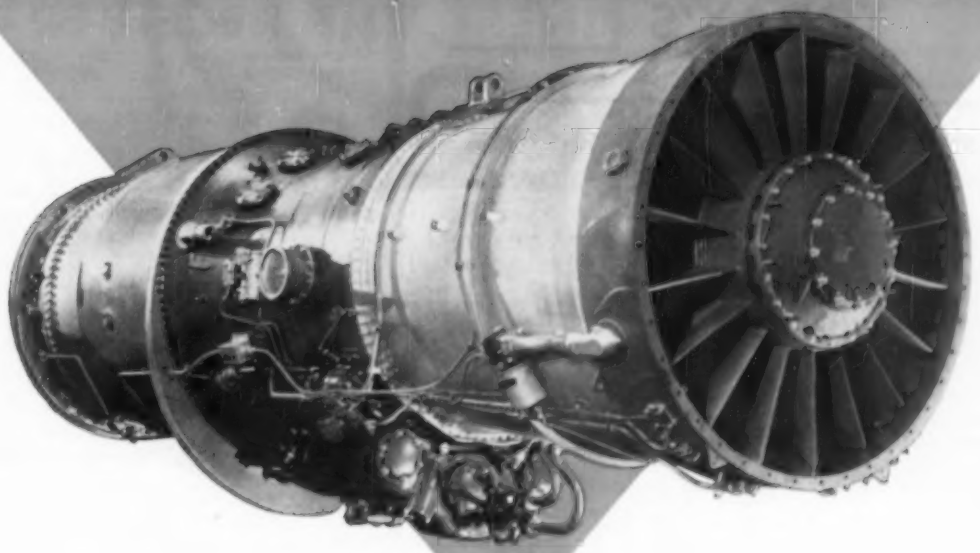
Oct. 30—Aviation Electrical Equipment Display, U.S. Grant Hotel, San Diego, Calif.

Nov. 5-7—Joint Military-Industry Guided Missile Reliability Symposium (limited to those with Secret security clearance), Naval Air Missile Test Center, Pt. Mugu.

Nov. 6-8—Third Annual Symposium on Aeronautical Communications, Hotel Utica, Utica, N. Y.

Nov. 18-29—International Air Transport Assn. Technical Conference, Miami, Fla.

It's quite an engine...the J75

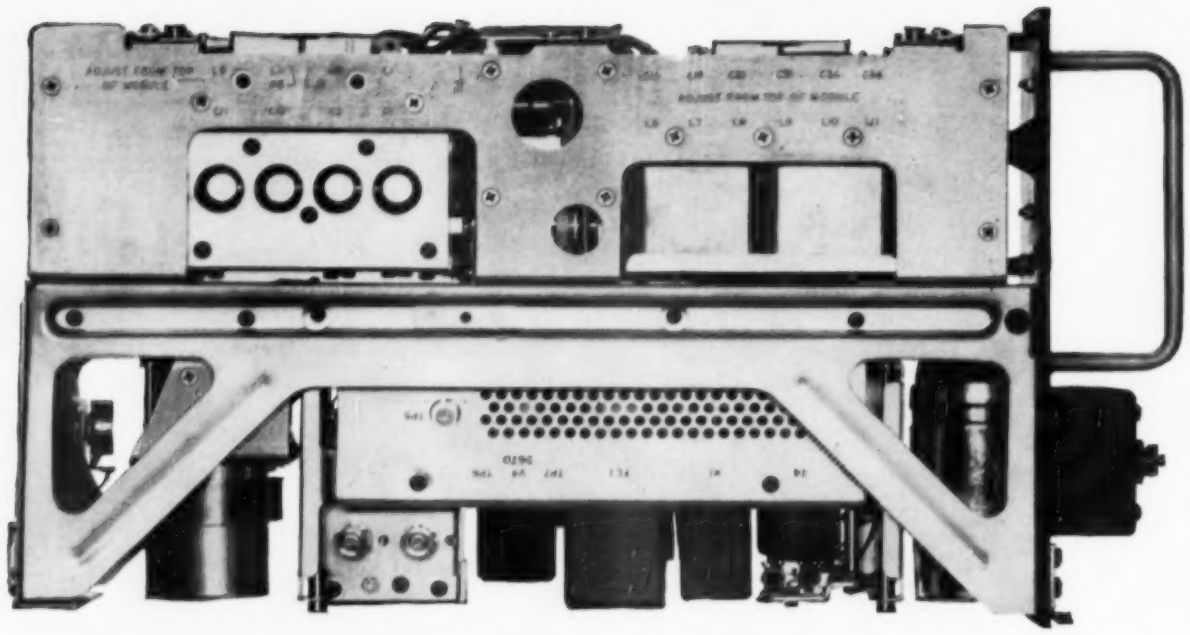


Pratt & Whitney Aircraft win our admiration and praise for the engineering, tooling, and production problems they solved in getting the high-thrust J75 to operational status. We are proud that the Jet Division of Thompson Products supplies parts for the turbine-and-compressor section of the J75.

JET DIVISION

Thompson Products, Inc.

Cleveland 17, Ohio

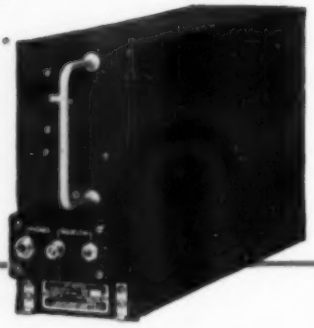


TODAY'S FINEST VHF RECEIVER

Collins 51X-2

Lightweight. Compact yet all components accessible. *Modular construction. Increased reliability* through use of advanced circuit design, derated components; cooler operation — only 27 watts dissipated in unit; high electrical performance. Outstanding *system performance* through improved cross-modulation, desensitization and IF selectivity characteristics. *Double Tuned RF* provides excellent ATCSS operation.

These are only a few of the many reasons why Collins 51X-2 is today's finest VHF receiver. A part of Collins new Airborne Electronic System, the 51X-2 will be integral to the electronic system in many aircraft — international, domestic, local service and business fleets.



Weighs only 10.5 pounds
Receives VOR, LOC, Comm, TVOR
Tunes 108 through 151.95 mc
880 channels
Crystal controlled
Short 3/8 ATR case

communication · navigation · control

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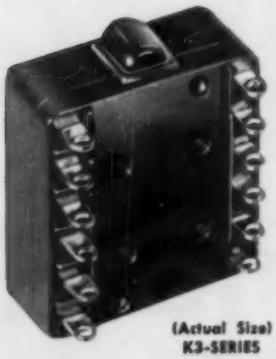


(Actual Size)
K3-SERIES

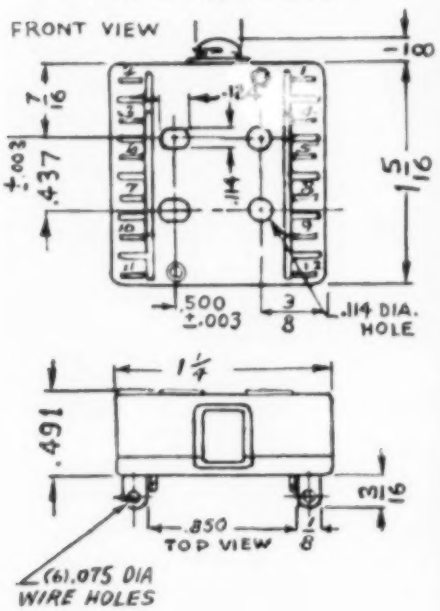
TRIPLE-POLE SWITCH

OPERATING CHARACTERISTICS

CONTACT ARRANGEMENTS:
K3-4—TRIPLE-POLE, DOUBLE THROW
K3-2—TRIPLE-POLE, NORMALLY OPEN
K3-1—TRIPLE-POLE, NORMALLY CLOSED

ELECTRICAL RATING:
15 AMP 125/250 V.A.C.
15 AMP 30 V.D.C. RESISTIVE
10 AMP 30 V.D.C. INDUCTIVE

PROBABLE MECH. LIFE.....1,000,000 OPS
PROBABLE ELEC. LIFE..... 500,000 OPS
AMBIENT TEMP. RANGE.....—100° TO +275° F.*
*(—100° to +375°F. available)



ELECTRO SNAP SIMULTANEOUS

TRIPLE-POLE SWITCH

for interrupting 3-phase,
110 V, 400 cycle AC circuits

6-CIRCUIT CONTROL — in a small package.
Makes possible a wide variety of circuit combinations.

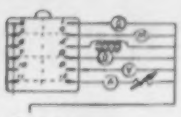
SIMULTANEOUS "MAKE & BREAK" ACTION
Permits unusual applications, reduces arcing, prolongs switch life and increases electrical capacity.

This sturdy, compact Electro-Snap triple-pole switch simultaneously reverses current flow through three windings of a 3-phase motor up to 1 H.P. and interrupts other types of multi-switching installations. Instantaneous snap-action of the three poles is independent of the speed of actuation—even extremely slow moving cams can be used.

The K3-Series offers designers a wide variety of 3-phase circuit hookups for servo-controls, to limit movement of machine members and as a start-and-stop switch which formerly were possible only with complicated relays or a number of separate switches. A large selection of standard actuators is available.

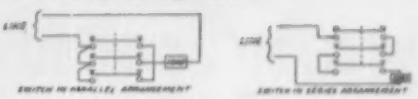
LOOK WHAT YOU CAN DO WITH IT!

Control Six Circuits with ONE Snap



Used in motor control device switch, when actuated, turns on the red light on No. 1, the solenoid on No. 5, the voltmeter on No. 9 and turns off the motor on No. 4, the green light on No. 8 and the furnace and ammeter on No. 12.

Wire Movable Poles in Series for High Voltage or in Parallel for High Current

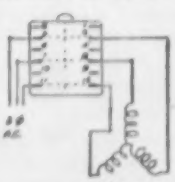


With the switch wired in parallel arrangement, the current is divided into 3 paths through the switch. This permits the switch to be used with a load rated up to 3 times the ampere rating of the switch.

With the switch wired in series arrangement, the current has only 1 path through the switch. The multiple breaks in the current path permits the switch to be used where the line voltage is rated up to 3 times the voltage rating of the switch; ampere rating not affected.

Start and Stop Three-Phase Motors

Completely disconnect all current supplied to a 3-phase motor by interrupting 3 phases simultaneously with one snap.



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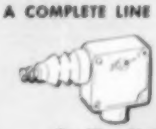
SWITCH AND MFG. CO.
4232 West Lake Street • Chicago 24, Illinois

MODERN DESIGN IN A COMPLETE LINE OF SWITCHES

Sub-Miniature Switches

Multi-Pole Switches


One-Way Limit Switches

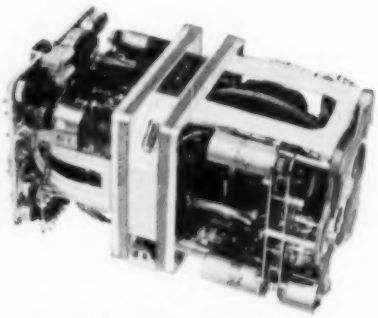
Basic Switches

Hermetically-Sealed Limit Switches

LOW ALTITUDE BOMBING SYSTEM—one example of how new 2-gyro system meets all-attitude stabilization requirements.

Satisfies stringent demands of MISSILES, too.

On ANTI-SUBMARINE WARFARE planes, new system eliminates DIRECTIONAL GYRO gimbal error and feeds error-free heading information.



Bendix 2-Gyro System weighs only 19 lbs. and measures only 6" x 6" x 12", including all amplifiers.

NEW! BENDIX 2-GYRO ALL-ATTITUDE CONTROL

basic reference for today's needs— saves 50% on cost and weight

This new 2-gyro system was specially developed by Eclipse-Pioneer to fill today's critical need for a *low-cost* master control reference combining vertical and directional gyros in continuous, high-precision performance through all attitudes and altitudes.

Extensive performance tests show the Bendix system's accuracy holds during rolls of 360° a second, loops of 80° a second and other high-rate maneuvers. Under test the new system has withstood 10G of vibration on its two horizontal and 1 vertical axes. Azimuth drift rate is 1° per hour maximum. Vertical drift rate is ¼° per minute maximum.

Bendix 2-Gyro All-Attitude Control will fully satisfy performance requirements in 90% of today's applications. And it offers the additional advantages of being half the cost and weight of 3-gyro systems.

This new 2-gyro system will be of interest in both commercial and military fields. Ask for details.

District Offices: Burbank and San Carlos, Calif, Dayton, Ohio; and Seattle, Wash.

Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.

ADVANTAGES OF BENDIX 2-GYRO ALL-ATTITUDE CONTROL—

VERSATILE—*replaces all vertical and directional gyros used for indication, auto pilot control, navigation, fire control, radar stabilization and other functions.*

ELIMINATES DG GIMBAL ERROR.

NO GIMBAL LOCK—*functions with complete accuracy, even in extreme attitudes.*

ELIMINATES INTERMEDIATE AMPLIFIERS—*with new electrolytic switches handling all power erection direct.*

SMALLER, MORE RELIABLE, LONGER LIFE—*because of improved and transistorized servo amplifiers.*

MEETS REQUIREMENTS OF MIL-E-5272.

Eclipse-Pioneer Division

TETERBORO, N. J.

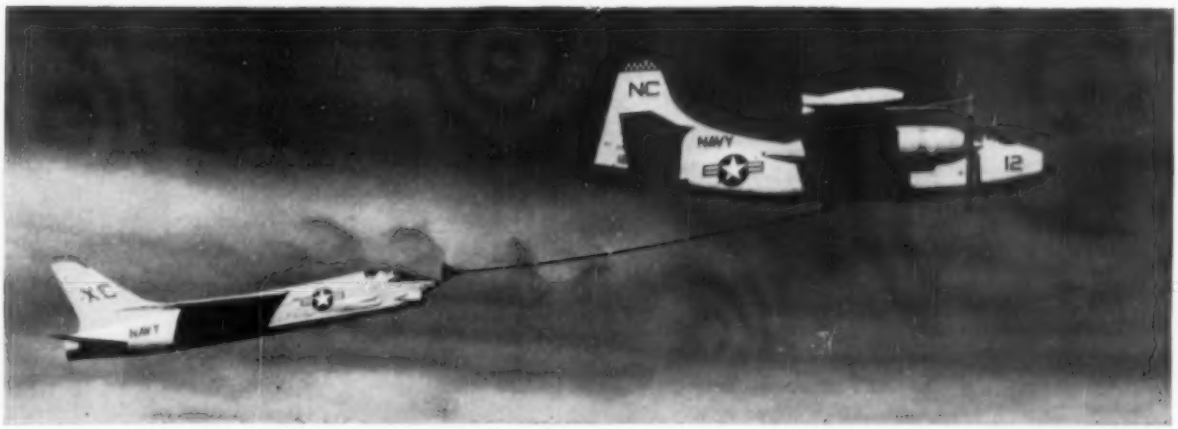
Bendix AVIATION CORPORATION

OPERATION BULLET . . .

"Sustained capability at near-maximum power over a long distance",
Faster than the speed of a 45-caliber bullet the Chance Vought F8U-1 Crusader breaks the official cross-country record . . .
Not only a challenge of speed but of endurance requiring extraordinary performance in components - components built to the most rigid requirements.
Sculptured components in critical areas contribute to the bullet-like efficiency of such record breaking performances -

Chance Vought F 8U-1 Crusader

truly **sculpture in motion.**



Chance Vought F 8U-1 Crusader refueling in flight.

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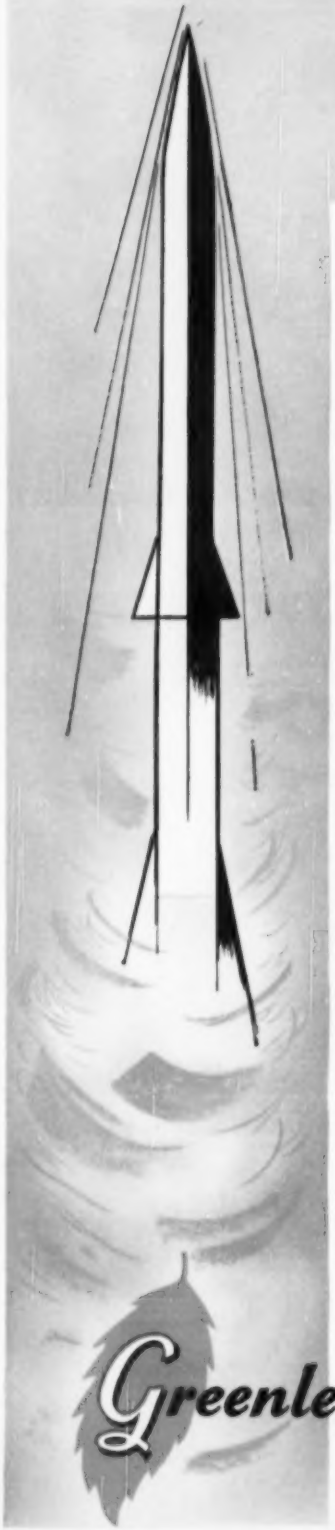
complete facilities for the manufacture and assembly of Aluminum, Titanium, Steel and Hi-tensile metal Aircraft and Missile components.

to users of integrating gyros

AND IF YOUR SYSTEM REQUIRES AN INTEGRATING GYROSCOPE...



It is important that the Gyro be *truly* integrating.

The following are a few basic checks that can be simply made to determine whether the Gyro is a true integrating Gyroscope.

1. With Gyro at null, rotate Gyro about its input axis in a positive (clockwise) direction approximately 50 milliradians.
2. Observe the output voltage and polarity. A true integrating Gyro should show a positive output of a magnitude determined by the product of the angular displacement in milliradians and its rated sensitivity (millivolts/milliradians).
3. The output should remain at this reading providing there is no further input (either angular or command). At this point no drift is being taken into consideration. However, all gyros will drift to a greater or smaller degree. Observe this drift as to direction and magnitude with respect to time.
4. Repeat the above with a negative (counter clockwise) input of approximately 50 milliradians.
5. Observe the output voltage and polarity. A true integrating Gyro will show a negative output equal to the product of angular displacement in milliradians and its rated sensitivity (millivolts/milliradians) and hold this output.
6. If the Gyro tends to return to null in both of the above conditions, it is not a true integrating Gyro.

If you have made the foregoing checks and wish any further information, please call on Greenleaf. It is our sincere desire to provide the utmost in service to Integrating Gyroscope users.

THE

Greenleaf MANUFACTURING COMPANY

A DIVISION OF MANDREL INDUSTRIES, INC.

7814 Maplewood Industrial Court, Saint Louis 17, Missouri

Simplify Fastening and Joining Problems with MARMAN Straps, Clamps and Couplings

Simplify design . . . speed production line assembly . . . assure better performance and quick, easy maintenance! Use Marman high performance Clamps, Straps and Couplings wherever possible for airframe, engine, and accessory fastening and joining applications. Marman offers many sizes and types that meet all temperature, vibration and pressure requirements.

Complete engineering assistance is available. If you want product information, write for Band Clamp Catalog 10; V-Band Coupling Catalog 40; or the "J" Series Aircraft Joint Bulletin.

Marman J-11 LIVE Joint Systems

For connection and disconnection of aircraft tubing. Flange ends mate with all-metal gasket to provide positive seal for fluid and gaseous systems up to 2000 psi. in 1" size, at operating temperatures from —300°F. to +1000°F., available in 1" to 12" O.D. tube sizes.

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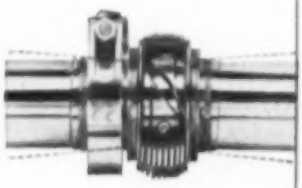

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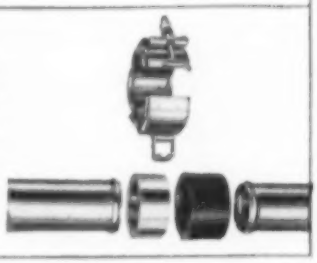

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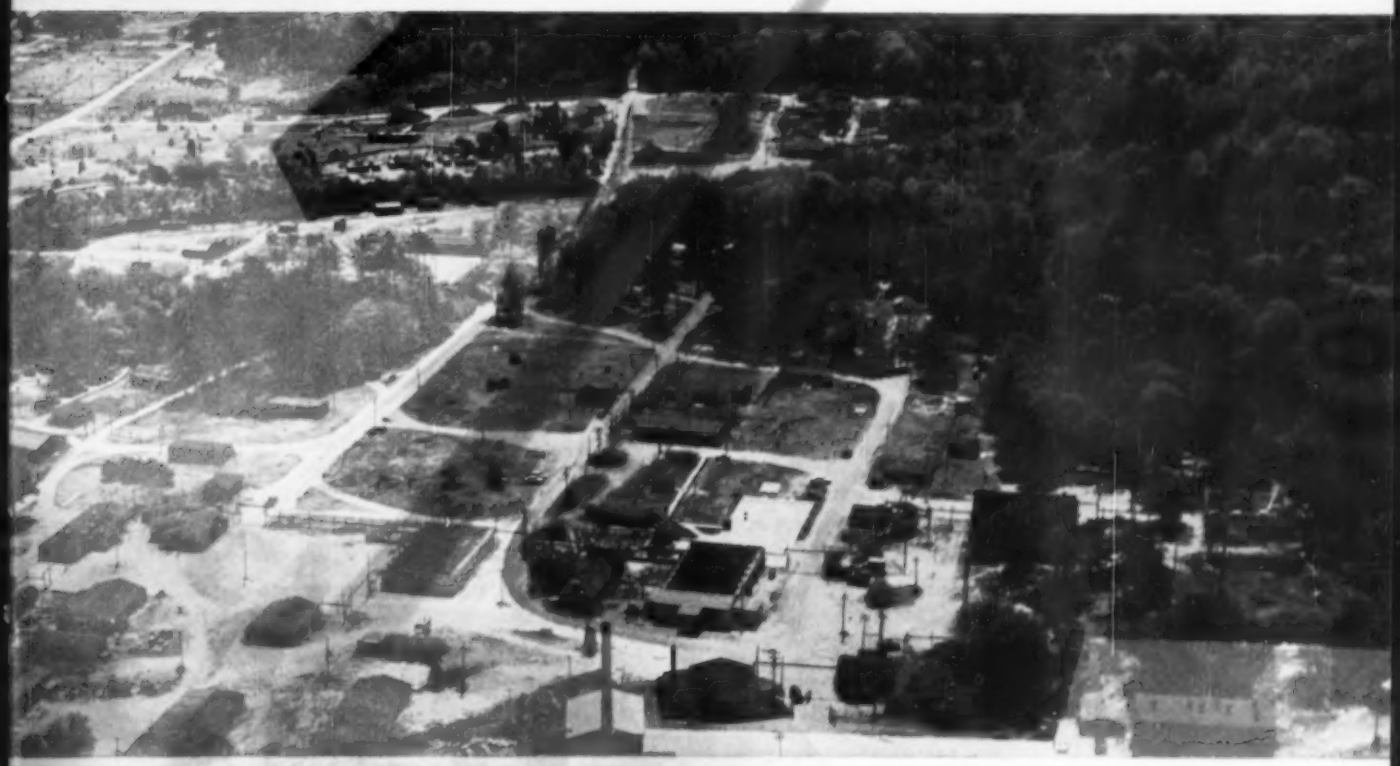

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Gen. Baker Assumes Capital Presidency 39
► Carmichael will direct policy as board chairman; financial expert Baker plans tighter economy.

Space, Weight Gain Boom Liquid Oxygen 88
► Military use is well advanced, but airlines are concerned with handling problems.

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COVER: Canadair CP-107 Argus, on a test flight from Canadair's Montreal plant, shows revised fuselage but wing and tail configuration of Bristol Britannia, from which it was adapted. The aircraft, designated CL-28 by the company, uses piston engines for low altitude endurance for its Royal Canadian Air Force mission of overwater patrol and anti-submarine detection.

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EDITORIAL

Aviation's Problems Multiply

As most industries slide into the summer doldrums the aviation industry is boiling with a wide variety of management problems. We warned as this year began (AW Jan. 7, p. 21) that 1957 would be a year in which the aviation industry, both in its manufacturing and transport segments, would have to solve some knotty problems to insure continued prosperity. As we pass the mid-year mark it is clearly evident that the problems we outlined have grown more acute and have been joined by another group precipitated primarily by government policies. These government policies are both short-sighted and dangerous because, unless modified, they will undermine the foundations of our national defense and our national air transport system.

Pattern of Confusion

Perhaps the most serious problem is the fiscal muddling now going on in the Pentagon. Veteran executives who have battled through the feast and famine cycles of the aircraft industry for the past 30 years tell us that never in history has the fiscal maneuvering of the defense business been in such a confusing muddle.

Congress has been thoroughly confused by the almost weekly signal reversals it received from the Pentagon and the White House on the Fiscal 1958 defense budget. The military services which procure complex hardware for aerial weapon systems have been thoroughly confused by the fiscal directives and subsequent reversals that have descended on them from the Secretary of Defense's office. And the contractors trying to do business with the Pentagon under a constantly shifting set of fiscal policies are in a genuine financial bind.

Economic Imagery

To further complicate the issue, nobody has advanced a single step in the direction of obtaining new renegotiation procedures that effectively prevent profiteering on defense business but also permit legitimate business to operate efficiently.

Irony of all these confused fiscal policies, most of them advanced in the cause of alleged economy, is that they are costing and will cost the taxpayers of this country untold millions for which nothing tangible will be received. It is also ironic that when any proposal appears—such as the recommendations of the committee headed by Ralph Cordiner, chief executive of the General Electric Co., on an equitable pay scale for military technicians—it is quickly junked as "inflationary." Implementing the Cordiner committee's report would soon slice from two to three billion dollars from the defense budget—a welcome relief for all taxpayers.

In the airline business the financial squeeze is also coming from government policy. The Civil Aeronautics Board staff has its own methods of bookkeeping to prove airline profits are much higher than they are and chooses to ignore the rising cost curve that is cutting profit margins dangerously thin. It is also standing supinely by while United States domestic traffic rights are being traded away to foreign airlines.

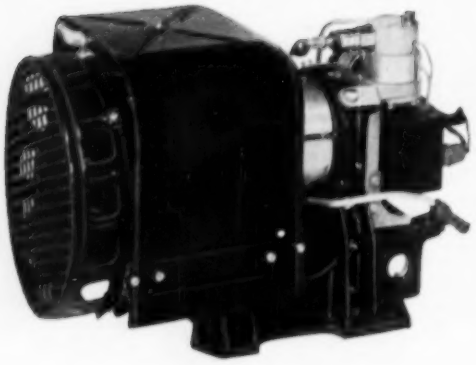
Progress on providing adequate traffic control and ground facilities for the jet age is still painfully slow. A prime example is the senseless controversy over providing an airport adequate for jet transport to serve Washington, D. C., the nation's capital. Maryland and Virginia senators will still be wheezing debate on this subject when jet transports swish by Washington on their way to serve cities that have provided adequate facilities.

Better Information Policy

Aviation in both its military and civil aspects is an essential part of this nation's economic and political strength. As such it certainly deserves more detailed and intelligent consideration from both the legislative and executive branches of the government. However, managers of the aviation industry cannot hope for much better consideration from the government agencies which are properly charged with regulation of their business unless they themselves make more of an effort to keep both the government and the citizens who elect it far better informed on the vital issues facing aviation today.

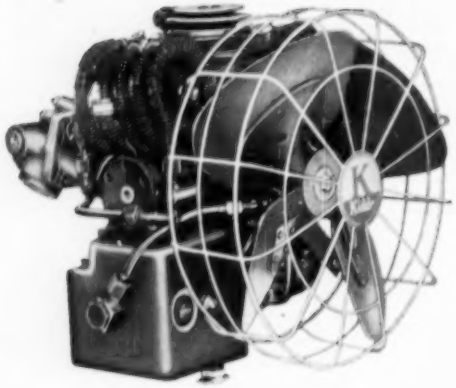
The time for internecine battling within the aviation industry has long since passed. Unless it is prepared to accept the full, disastrous consequences of its current problems the aviation industry had better start speaking loudly and clearly with a unified voice.

—Robert Hotz

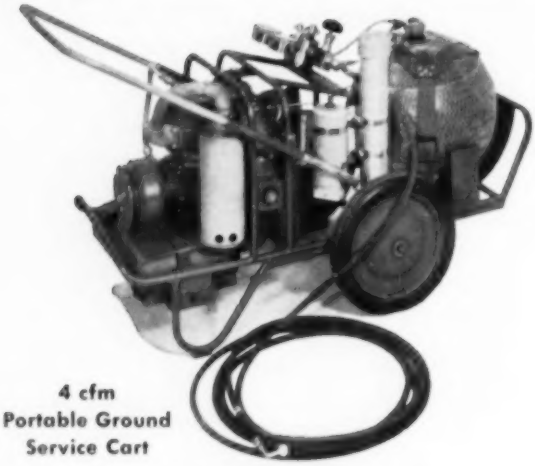


2 cfm Compressor Package

4 cfm Compressor



6 and 8 cfm Compressors



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Richard W. Millar, a director, Turco Products, Inc., Los Angeles, Calif.

Dr. John L. McLucas, president, Haller, Raymond and Brown, Inc. (State College, Pa.), division of Topp Industries, Inc., Beverly Hills, Calif. Dr. McLucas succeeds **Robert V. Higdon** now vice president-long range planning, Topp Industries.

Matthew J. Betley, president, Titeflex, Inc., Springfield, Mass.

I. J. Hammill, executive vice president and managing director, Walter Kidde & Company of Canada Ltd., Montreal, Canada. Mr. Hammill succeeds **C. K. McLeod** now board chairman.

Anthony L. Conrad, vice president-government service, and **Stephen D. Heller,** vice president-missile test project, RCA Service Company, Inc., Camden, N. J.

Norman Perlmutter, vice president, Systron Corp., Concord, Calif.

Allan F. Bonnalie, assistant vice president-flight operation, United Air Lines, Inc. **J. G. Brown** succeeds Mr. Bonnalie as director of flight training. Also: **N. F. Timper,** superintendent of flying, and **T. M. Plunkett,** manager-operations planning.

H. Donald Cameron, assistant vice president-operations, Canadian Pacific Airlines.

Honors and Elections

Dr. James T. Grey, Jr., head of the Chemistry Section of Cornell Aeronautical Laboratory, Inc., has been appointed scientific advisor to the Air Force's Directorate of Research and Development, Washington, D. C. Dr. Grey is on leave of absence from the Laboratory.

Carter L. Burgess, president of Trans World Airlines, Inc., has been elected a director of J. P. Morgan & Co. Incorporated, New York, N. Y.

Dr. Ernst Weber has been appointed acting president of Polytechnic Institute of Brooklyn, N. Y. succeeding Dr. Harry S. Rogers, deceased. Dr. Weber is vice president for research at Polytechnic.

Changes

Dr. Martin J. Gould, director of research, National Electronics Laboratories, subsidiary of Thickol Chemical Corp., Washington, D. C. **K. W. Hoover** and **H. R. Corbett, Jr.,** senior electronic research engineers, are assistants to Dr. Gould.

Leonard Brewer, project director-rocket engines, Research and Development Dept., Explosives Division, Olin Mathieson Chemical Corp., East Alton, Ill.

Harry McPherson, to head testing program-missile weapons systems, Temco Aircraft Corp., Dallas, Tex.

William E. Haines, Washington, D. C. representative, H. K. Porter Company, Inc., New York, N. Y. Mr. Haines succeeds **E. G. Counselman** now manager-industrial sales.

INDUSTRY OBSERVER

► Flying pipe aerial refueling buddy system is being considered for Republic Aviation Corp.'s F-105 to give the supersonic aircraft a tanker capability. Gear consists of a retractable folding arrangement with a single drogue-tipped tube swiveled between two other tubes connected to external tank.

► **Pogo High, infrared heat source developed by Naval Ordnance Test Station for Sidewinder missile target practice, is shot to 50,000 ft. by a missile using a Sidewinder solid propellant motor. Parachute lowers the pod of slow-burning thermite mix which serves as an infrared emanator equivalent to four engines of a piston-powered aircraft.**

► Rolls-Royce Conway bypass engine has exceeded its civil rating of 16,500 lb. static thrust (AW June 10, p. 23) on test stand runs at the Rolls plant in Derby. Military rating is 17,150 lb. thrust. Commercial versions are scheduled for some Boeing 707 and Douglas DC-8 jet transports with the military version slated for an advanced version of the Handley Page Victor bomber.

► **Pyroceram nose cone for Convair Tartar surface-to-air destroyer-based missile is under evaluation at Johns Hopkins Applied Physics Laboratory. Material is machinable, minimizes radar distortion. Navy Tartar is lighter than Terrier, requires about five avionic consoles for search, track and fire control as compared with approximately 20 for Terrier.**

► Radars made by Cossor in England are now being delivered to key NATO stations along the Iron Curtain. Units have a range of almost 400 mi., can detect and monitor flight operations of individual fighter planes well inside Eastern Europe.

► **Douglas Aircraft is building a mockup of an anti-missile missile now under development incorporating a nuclear warhead.**

► West German Air Force will flight evaluate the Grumman F11F-1F supersonic fighter within the next few weeks as part of an overall study of available new high-performance planes needed to modernize its air arm.

► **New aerodynamic modifications on Sud Aviation Vautour tactical bomber and night fighter for the French Air Force include leading edge extensions outboard of pod-mounted nacelle and slab tail. Fourth production Vautour is being fitted with one-piece tail, seventh prototype has been flying with new leading edges. Both will be standardized on future Vautours, and leading edge extensions will be retrofitted on all production planes.**

► Douglas Skyhawk A4D-3, advanced version of the A4D which Navy's Bureau of Aeronautics decided not to build (AW July 1, p. 28), was to have been equipped with Martin's air-to-surface Bullpup missile. For performance boost, the aircraft was to have been powered by Pratt & Whitney's new J52 which offers lower specific fuel consumption and is considerably lighter than the Wright J65 being used in the A4D-2s.

► **Pantobase version of Grumman Aircraft's Army-Marine high-performance aircraft (AW May 27, p. 28) has been designed by the Bethpage, N. Y., firm. Layouts also have been made of a five-seat "bush-type" civil version of the aircraft.**

► Gyrodyne Corp. of America, St. James, N. Y., probably will not attempt to obtain Civil Aeronautics Administration certification of its one-man XRON-1 rotorcycle helicopter for at least another 18 months despite increasing inquiries for a civil version. Military development and production programs will delay certification attempts for at least that long. A company source says a commercial XRON-1, produced in lots of 100 to 500 might sell for as low as $5,000 each.

► **Sidewinder air-to-air missile equipped with exercise head instead of expensive explosive warhead is being used for fleet pilot training. If missile misses target, white flash results; red flash occurs with hit. Flashes are tracked from firing aircraft and surface stations.**

Checking control cables prior to installation in the North American F-100 Super Sabre

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Washington Roundup

Defense '57 Expenditures

Defense Department expenditures during Fiscal 1957 totalled approximately $38.2 billion, some $2 billion more than the administration had counted upon. Of this, major procurement and production accounted for $13.6 billion, including $8 billion for aircraft, $2 billion for guided missiles. Operations and maintenance expenditures were $9 billion; research and development, $1.7 billion.

Committee Tangle

Some members of the House Armed Services Investigating Subcommittee are dissatisfied with the handling of its investigation of aircraft engine manufacturers by chairman Rep. Edward Hebert (D.-La.). When Hebert claimed that USAF had wasted $25 million on a contract with Curtiss-Wright Corp., (see page 38) and then jumped to a public hearing on an airframe contract with General Motors Corp. without substantiating the charge, Rep. Frank Osmers (D.-N. J.) called the investigation "a headline hopping expedition" containing "intemperate charges without hearing both sides." Osmers demanded that "we get on a subject and conclude a subject." Hebert said in rebuttal that he is waiting on Curtiss-Wright President Roy T. Hurley to review USAF records before going further.

The Subcommittee's hearing schedule calls for Pratt & Whitney Aircraft Division of United Aircraft Corp. on July 29 and 30; Westinghouse Electric Corp., July 31; General Electric Co., Aug. 1; Continental Aviation and Engineering Corp., Aug. 5; Ford Aircraft Engine Division, Ford Motors Co., Aug. 6; Lycoming Division of Avco Manufacturing Corp., Aug. 7; Allison Division, General Motors Corp., Aug. 8.

New NACA Member

National Advisory Committee for Aeronautics has a new committee member, Rear Adm. Wellington T. Hines, assistant Bureau of Aeronautics chief for procurement and until recently BuAer general representative at Wright-Patterson AFB, Ohio. Adm. Hines succeeds Rear Adm. Carl J. Pfingstag, former assistant BuAer chief for field activities and now force maintenance and materiel officer of the Atlantic fleet.

Close USAF Audits

Air Force is taking steps to assure close audit reviews of forward-pricing proposals of its contractors as a result of a General Accounting Office investigation of a contract for 599 F-84F aircraft with General Motors Corp.'s Buick-Oldsmobile-Pontiac Assembly Division at Kansas City. GAO charged that, because of faulty cost calculations on two redeterminations, General Motors realized an excess profit of $17.4 million. I. J. Powers, chief of GAO's Defense Accounting and Auditing Division, presented a report on the investigation to House Armed Services Investigating Subcommittee. It was part of GAO's accelerated program of reviews of military aircraft procurements (AW April 1, p. 26).

USAF has concurred that the excess profits were attributable to the failure of contracting officials to analyze and evaluate effectively GM's forward-pricing proposals. Three USAF attempts to obtain a refund have been fruitless. General Motors has maintained that "the adjustment of contract prices to effect a revision of earned profit ratios is a matter for internal consideration. . . ." GAO is now making a study "as to the legal validity of the negotiated prices."

GAO charges that the GM price proposals in the two redeterminations did not reflect known reductions in subcontractor prices, labor, overhead and other costs.

Air Force Economics

Further attempts to brief industry as completely as possible on current and future procurement situations will be made by Air Force at this week's Air Force Assn. convention in Washington.

Official theme of the meeting is the golden anniversary of the Air Force. Unofficial theme seems to be economics in the aircraft industry. On Wednesday, USAF Secretary James H. Douglas will bring industry up to date on developments since his June 20 Pentagon conference with aircraft executives (AW June 24, p. 26). Officials of the Air Materiel Command and Air Research and Development Command will follow suit.

Belgium Bilaterals Suspended

Mounting concern in Congress over the Dutch and Australian air agreements concluded by the State Department this year is believed to be one of the major factors behind last week's suspension of bilateral talks with Belgium. Legislation has been introduced in Congress designed to prohibit what airlines term as a "giveaway of U.S. air rights to foreign airlines" (AW July 15, p. 25). The Dutch and Australian air transport, along with the German air bilateral in 1955, were criticized as violations of the United States civil air policy, according to the industry, in that the foreign carriers received more benefits than U.S. carriers received in return.

It was reported that the Belgians sought additional routes in the United States, including rights to fly to the West Coast and to Miami and points beyond.

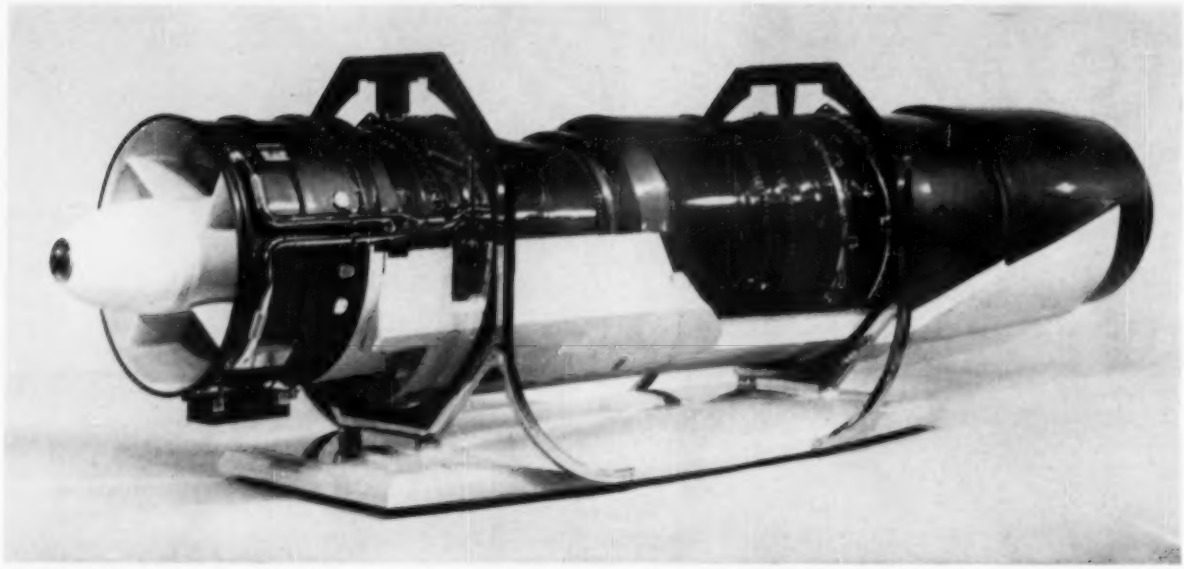
Wilson Warning

Defense Secretary Charles E. Wilson has urged that "contractors be made acutely aware" that unauthorized disclosures of classified defense information "if sufficiently serious, are grounds for withdrawal of security clearances of offending individuals and, in extreme cases, for denying a company an opportunity to participate in future government contracts, as well as for prosecution."

This warning is a part of Wilson's implementation of recommendations made last year by the Coolidge Committee on Classified Information (AW April 22, p. 25). Coolidge suggestions were aimed as much at eliminating overclassification as at stopping "leaks." But Wilson's implementations appear to strengthen specific authority to classify without meeting the problems of unnecessary classification and overclassification—except to say that they shall be "scrupulously avoided."

Rep. John E. Moss (D.-Calif.), House Government Information Subcommittee chairman, said the implementation orders give him "no feeling of optimism that the revisions will in any way bring about a freeing-up of information which should not be classified but has been classified in the past."

—Washington staff



ORENDA IROQUOIS engine design feature is the longitudinal firewall running along the lower portions of the engine (painted white). This encloses all of the fuel and hydraulic lines. Afterburner fuel lines, which are exposed, are normally covered by an annular casing. Firewall keeps combustible liquids out of the flow of air passing over the engine to the afterburner nozzle.

Iroquois Based on Supersonic Efficiency

Sacrifice of some subsonic performance was made to fit engine for extended operation above Mach 1.

By J. S. Butz, Jr.

Malton, Ontario—Orenda Iroquois turbojet engine developing about 23,000 lb. of thrust has been designed for maximum efficiency in supersonic flight at the expense of a slight reduction in subsonic performance.

This sacrifice is inevitable without variable geometry compressor and turbine blades, and it indicates that the Iroquois is intended for use in aircraft which fly a large percentage of their mission above Mach 1. Iroquois will power Avro CF-105 Arrow.

Afterburner Design

The afterburner has been an integral part of the design since its inception and boosts thrust to over 30,000 lb.

The Iroquois, which is the largest engine known to be in an advanced development state in a Western nation, was shown publicly for the first time last week at its home plant.

Orenda claims a significant weight saving in the engine, which is approximately 20 ft. long, 4 ft. in diameter. It has twin spool compressor, an annular combustion chamber, and it makes extensive use of titanium and other new alloys.

Decision to design for maximum supersonic efficiency was made in September, 1953, when the project was begun. It was estimated that by the time the Iroquois reached service, aircraft would require supersonic speeds for more than a few minutes during combat. Therefore, the importance as well as length of subsonic cruise would be substantially reduced.

Orenda, a relatively small manufacturer with only two engine designs to its credit, was so convinced that its proposals for a very large engine could be realized in practice that it put $8 million of its own money into the original development effort. Fifteen months after this expenditure began the first test engine was running. Orenda did not receive financial support from RCAF until second engine was ready to run four months later.

The engine's development has now reached the stage that negotiations are in progress to license it for manufacture in the United States with Curtiss-Wright prominently mentioned as the licensee. Basic engine data is available to U. S. manufacturers and many of their new aircraft design proposals include Iroquois-powered versions.

Primary decision regarding good subsonic or good supersonic performance for an engine lies in the choice of the compressor pressure ratio. Low specific fuel consumption is attained by a high pressure ratio (and moderate turbine inlet temperature) at subsonic speed, and by a low pressure ratio in supersonic flight.

In most engines designed for good subsonic cruise the pressure ratio is about 12. Some large engines designed for long use at supersonic Mach numbers (e.g. the Rolls-Royce Gyron) the pressure ratio is about 6. The Iroquois is between these two figures so that subsonic performance is not too severely penalized.

Specific thrust, which is the other principal criterion for judging engine performance, requires a high turbine inlet temperature to reach a large value. At subsonic speed or about Mach .9 aircraft drag is relatively low and low specific thrust is sufficient. Therefore moderate turbine temperatures can be used with high pressure ratios to give good specific fuel consumption.

Heat Problems

As speed increases, the ram effect of the air entering the compressor raises its pressure and temperature. High pressure ratios further heat the air and bring it closer to the turbine inlet temperature which is the limiting value for the engine. This reduces the amount of fuel which may be burned.

The result of this ram effect is that low pressure ratios are required at supersonic speeds for low specific fuel consumption and maximum specific thrust. However, the maximum value of specific thrust falls off badly and the mass flow of air required for a given thrust gets very large. Afterburning then becomes

attractive because it boosts specific thrust (about 50% at Mach 2.5) and cuts the volume of air required so that the engine frontal area may remain small.

Use of a low pressure ratio has the added advantage of cutting engine weight because it requires fewer compressor stages. The twin spool design also cuts the number of stages because each spool can operate nearer the design point of its blades and remain more efficient over entire performance range.

Engine weight was further reduced by the use of many new alloys and raising the design stresses of older materials through better refining processes. Titanium was used extensively and Orenda is set up for welding, machining and fabricating this material.

A typical direct weight saving through titanium is in a compressor stage which weighs 77 lb. with steel wheel and blades and only 33 lb. when made of titanium. Further indirect savings are reduction in stresses transmitted to the shaft permitting lighter shafts and fewer bearings.

Therefore, use of titanium should result in greater weight savings than indicated by direct material substitution.

Thrust-to-Weight

The basic weight of the Iroquois would be around 5,900 lb. if the new estimates of variation in engine weight with thrust that have been made by Orenda engineers in technical literature have been achieved. This would give the engine nearly 3.9 lb. of thrust per lb. of engine weight, which is remarkable when compared to known figures for various other jet engines.

Another novel feature of the engine is the method of suspension. It is attached to the fuselage at five points in comparison to the more common three points. A series of links are used so that no radial loads are transmitted into the engine casing. The loads are all tangential and as a casing resists these more effectively than radial loads it can be thinner and lighter. Distributing the loads into five points instead of three also reduces local stresses in the casing.

Turbine blade cooling is probably being used on the Iroquois. Orenda has indicated that specific thrust is materially improved up to Mach 1.5 through air cooling. This delays the need for afterburner use and keeps sfc. down at moderate supersonic speeds.

Orenda has done considerable work in developing the hollow turbine blades needed for cooling. They have satisfactory blades for use up to 1,970F with air cooling, but their life is less than 50% that of a solid blade operating at lower temperatures. Orenda is also actively testing other methods of blade cooling which will be required at above Mach 2.5 if specific thrusts are to be raised above today's values.

Civil Applications

While the Iroquois is intended for military use at supersonic speeds its designers have strong arguments for its application in commercial transports with supersonic cruise speeds. Its basic compressor design would permit performance optimization at any low supersonic Mach number through slight turbine and compressor blade redesign.

In contrast to some other engines of foreign origin, the Iroquois has been designed to Canadian standards which are virtually the same as those used in this country. The differences are in such minor items as methods of wiring the cockpit for engine starting. The engine will also be manufactured by the same quantity production methods used in the U.S. therefore little or no additional design effort will be required for its use or manufacture here.

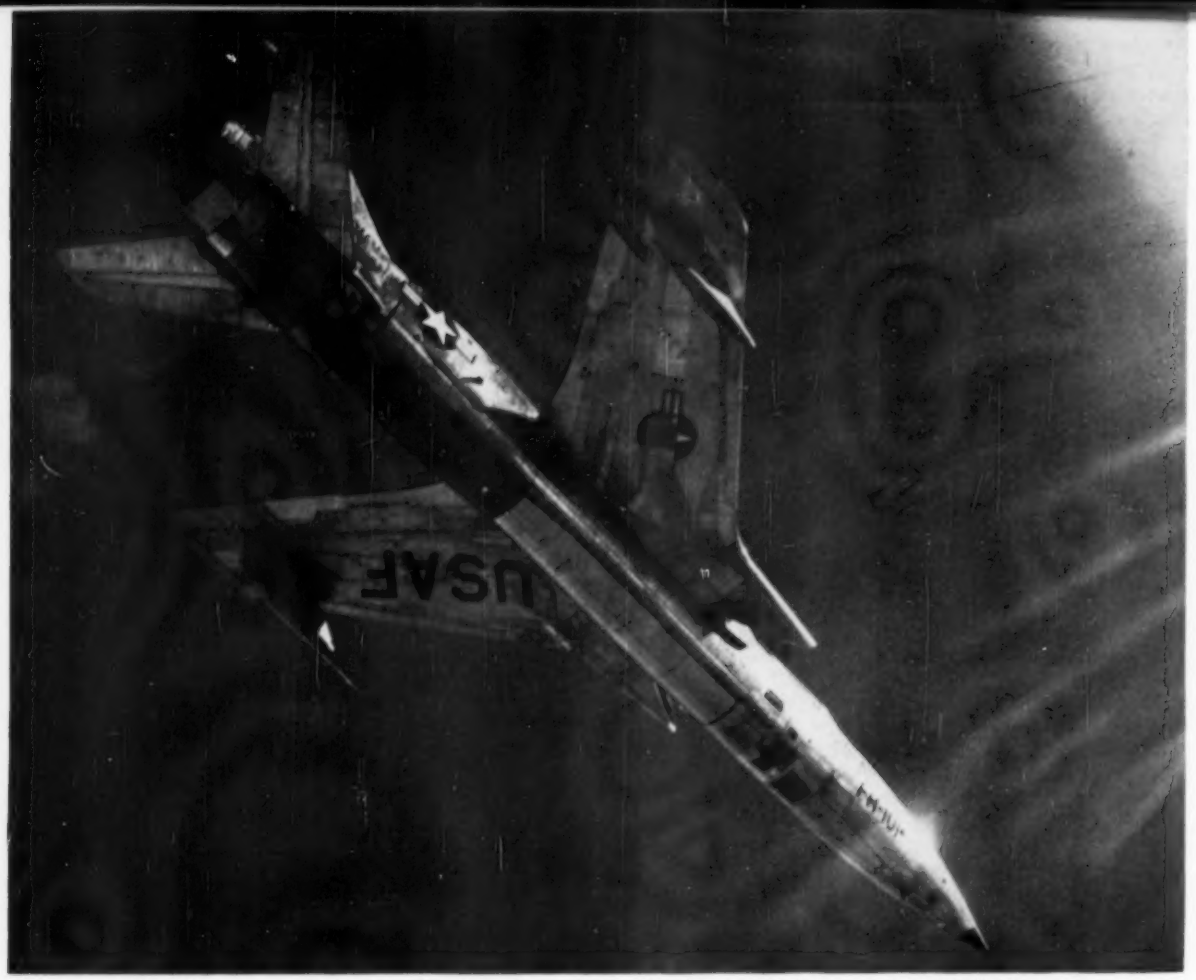
Etendard VI Unveiled

First pictures of Avions Dassault Etendard VI show basic similarity to Etendard IV predecessor. Unlike Etendard IV, which was powered by Snecma Atar 101E-4, the Etendard VI is powered by Bristol Orpheus turbojet rated 4,850 lb. thrust. Etendard VI, entered in NATO lightweight fighter competition scheduled to begin in September, has large low pressure tires for landing on unprepared fields. Next proposed development of Etendard is a tandem trainer for transition use after primary training in Fouga Magister.

Defense Appropriations

House and Senate conferees last week approved $33.7 billion in new funds for Department of Defense for Fiscal 1958. This compares with the $34.7 billion allowed for Fiscal 1957. In January, the Administration originally requested $36.1 billion for Fiscal 1958. Key allowances by the conferees in the aviation field were:

	Appropriation FY 1957 (000,000 Omitted)	Original Request FY 1958 (000,000 Omitted)	Approved by House-Senate Conferees FY 1958 (000,000 Omitted)
AIR FORCE			
Aircraft and related Procurement	$6,848	$6,200	$5,886
Research and Development	710	661	661
NAVY			
Aircraft and related Procurement	1,733	1,932	1,837
Research and Development	492	505	505
ARMY			
Research and Development	410	400	400



BELLY view of F-105 shows weapons bay beneath wing, pylons near tips also for stores. Main gear (below) folds into wing.

Intake, Speed Brake Design Are F-105

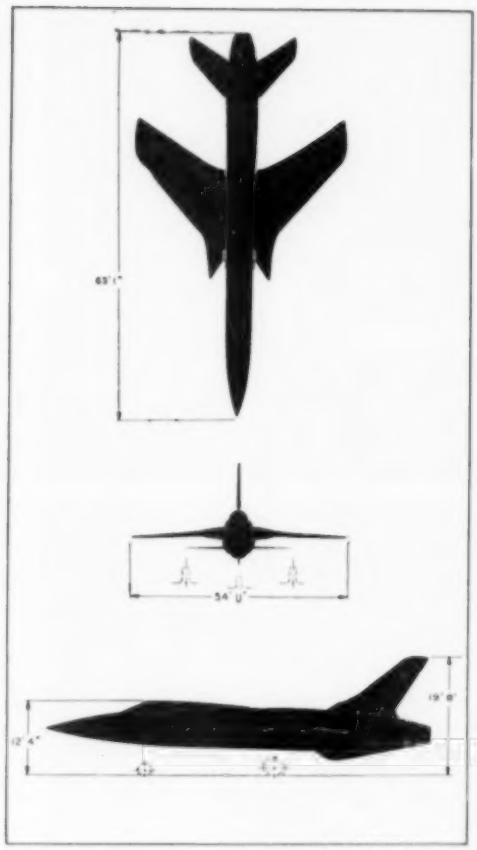
New York—Republic's F-105 Thunderchief supersonic fighter-bomber, shown publicly for the first time at the Air Force 50th anniversary show last week, incorporates several design departures: swept forward intake ducts at the wing roots, clover leaf speed brakes and a blend of conical camber and leading edge droop.

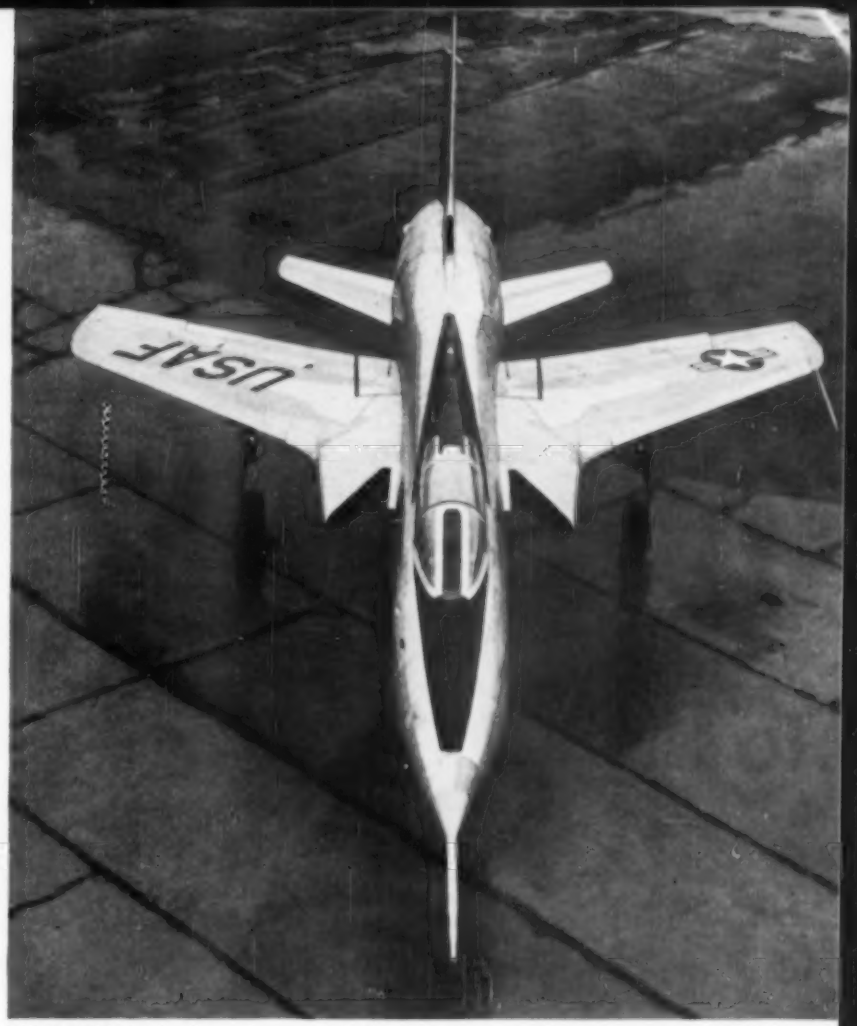
The area ruled F-105, which is 63 ft. 1 in. long, 19 ft. 8 in. high at the tail and has a 34 ft. 11 in. wing span, also incorporates an unusual fin ram air inlet for afterburner cooling (top right).

Powered by a Pratt & Whitney J75 engine developing 15,000 lb. thrust without afterburner, the F-105 can carry a heavy weapons load internally or externally. It was designed under the weapons system concept.

Not only do the ducts serve to position the shock wave at the best angle for supersonic performance, but they allow enough depth to house the main landing gear in the wing instead of the fuselage as in other high performance fighters—Lockheed's F-104 and Chance Vought's F8U, for example.

Republic says that the ducts addi-





WING ROOT intake ducts, fin ram air intake (top) are unique design features of the F-105. Ducts provide maximum recovery at supersonic speeds and reduce turbulence of flow to tail. Fin duct is for afterburner cooling. Actuators on tailpipe are for clover leaf speed brakes. Wing incorporates conical camber.

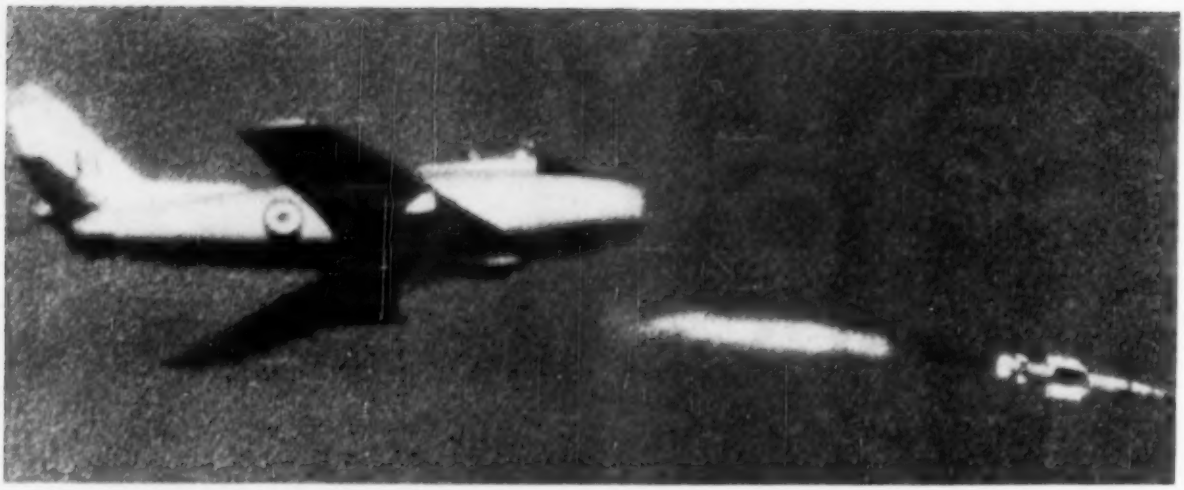
Innovations

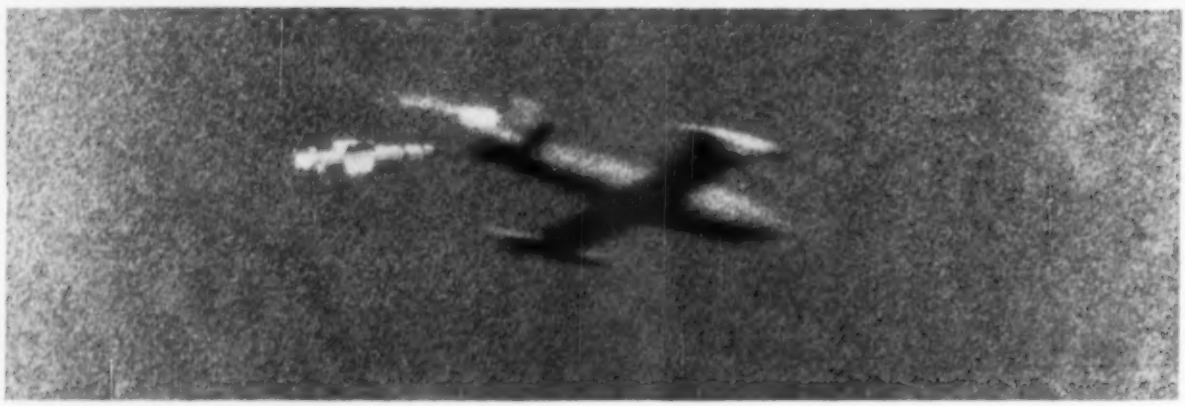
tionally reduce the turbulence of the flow against the tail to hold down buffeting.

Clover leaf speed brakes occupy the last 36 in. of the tail. They open into four petals with a sliding shield between them to form a solid circular brake area. Republic says this configuration provides more effective braking and at the same time more stability.

Camber of thin, short wing increases toward the wing tip to help prevent tip stall at high angle of attack. Leading edge droop provides means of altering degree of conical camber to provide most effective curvature for either cruising speed or supersonic speed. Conical camber reduces induced drag of a thin wing at subsonic cruise without compromising supersonic performance (AW Nov. 26, p. 26). Horizontal stabilizer is one-piece all flying type. Ventral fin is added for high-speed stability.

Air Force Assn. convention and Airpower Panorama at Washington this week will include flight of Ryan X-13 Vertijet and static display of Lockheed X-17, Bell Rascal, Hughes GAR-2A Falcon, Boeing Bomarc.





Firestreak, Bloodhound Home on Targets

Two British missiles, de Havilland Firestreak (top) and Bristol-Ferranti Bloodhound (bottom) are caught at instant before impact with aerial targets. Firestreak, fired from Sabre fighter over Australia's Woomera range at 40,000 ft., scored a hit on Jindivik drone. Bloodhound was photographed from camera mounted on wing of target aircraft in dry run. It was one of two fired; one hit and damaged target and the other passed within six feet of it. Proximity fuse would have fired and detonated second missile. Firestreak is infrared guided. Bloodhound, designed for long range, is powered by two Thor ramjet engines plus boosters for takeoff.

Russia Picks Tougher Satellite Orbit

Cranfield, England—Russia will place its earth satellite in a north-south orbit at a small angle to the meridian, Professor Boris Petrov of the Soviet Academy of Sciences told a three-day international symposium here on high altitude and satellite rockets.

The meeting was jointly sponsored by the Royal Aeronautical Society, the British Interplanetary Society and the Cranfield College of Aeronautics.

The Russians apparently are confident that sufficient velocity will be provided by their propulsion system to overcome the disadvantages of a north-south orbit. U.S. plans call for an orbit as close as practical to an east-west plane in order to take advantage of the earth's rotational velocity.

Reasons for the American choice were explained to the symposium by Milton Rosen, technical director for Project Vanguard.

Velocity Gift

"This earth rotational velocity is a gift, so to speak, of which the launching vehicle may take advantage by favorable choice of launching site and direction," he said. "Obviously the best condition would be to launch due east at the Equator, in which case the velocity gift would be 1,515 ft./sec."

Firing due east from the chosen site at Cape Canaveral, Fla., would provide 1,340 ft./sec. at an inclination of 28 deg. However, in order to permit observation of the satellite by observatories in the temperate zone, the inclination specified is approximately 35 deg. This will give an earth rotation contribution of 1,170 ft./sec.

Rosen pointed out that orbit requirements involve a balance between velocity performance and guidance precision—the more velocity available, the less precision required.

"The Vanguard approach," he said, "has been to maintain a substantial excess velocity capability and to hold the precision of guidance to that acceptable for a minimum performance vehicle."

The Russians, firing from a site in the Soviet Union, which in any event would provide less of a rotational contribution, apparently have decided to pass up the east-west advantage in favor of a north-south orbit that will give much greater coverage of the earth's surface.

It thus will be possible to observe the Russian satellite from all parts of the earth with the exception of central areas of the Arctic and Antarctic. Petrov said no date has been fixed for the first Russian launching, the number of attempts to be made will depend on initial success in achieving an orbit, he said.

Petrov headed a three-man Russian delegation to the meeting. He also outlined Soviet plans for firing a total of 125 high altitude rockets during the International Geophysical Year. These are to be launched from sites in the Soviet Union, in the Arctic and in the Antarctic.

Thirty firings are to be made between now and December from the Soviet Union itself between latitudes of 50 deg. and 60 deg. north. Another 40 will be made next year.

Rocket Firings

Twenty-five rockets will be fired next year from Franz Joseph Land, 80 deg. north latitude and 30 from the Antarctic in the area of Mirny, between 50 and 60 deg. south latitude.

He said the Soviet rockets will reach heights up to 125 mi. They will carry instrument cannisters for release at high altitudes and also will be equipped for telemetering.

One of the most interesting papers at the symposium was presented by Lt. Col. J. P. Henry of the Brussels Office of Air Research and Development Command. Col. Henry, looking ahead to manned satellites, suggested that one of the great psycho-physiological hazards of satellite travel might be hallucinations resulting from prolonged inactivity and lack of sensory stimuli.

He noted experiments which have been carried out decreasing the amount of information reaching an individual through normal sensory pathways. These included long periods in darkened, silent rooms and in well-lighted rooms in which a hum obscured all significant sounds.

"In all cases, sooner or later, either in a few hours or at most in three to four days, the men exposed to such sensory deprivation began to show symptoms," Col. Henry said. "They were subject to blank periods when they could not think and became depressed easily.

"Subjectively the most alarming symptom was the appearance of hallucinations. Starting with simple dots of light, lines and geometric patterns, they progressed as time wore on into more and more complex and well integrated waking dreams. These would even look like scenes from a motion picture. However, the images would sway and tilt on occasion in a nauseating fashion."

The ARDC official suggested that when there is too little information flowing into the brain from sense organs recording events in the outer world, the brain tends to overvalue perceptions generated by inner instinctual and emotional patterns.

Hallucination Prevention

Hallucinations and other side effects can be prevented, he said, providing there are sufficient interesting tasks and cues from the outer world for the brain's integrating mechanism to balance against what he called constant inner bombardment.

Col. Henry said there is a very real psycho-physiological hazard in the operation of a satellite vehicle for a prolonged period.

"If prolonged sub-gravity states were to be combined with darkness and lack of meaningful information from the environment within the vehicle, mental breakdown could be expected in many men in a few hours," he warned.

The manned satellite must be designed, he said, so that the human operator is constantly occupied with meaningful stimuli and significant tasks.

K. J. Bossart, former chief engineer of Convair's Atlas missile project and now technical director of Convair-Astronautics, outlined for the meeting some of the problems faced in the development of large missiles. He did not mention the Atlas by name but presumably much of what he said stemmed from experience with the intercontinental ballistic missile.

Bossart said that for optimum performance in large vertically launched missiles, the thrust should not be very much larger than the takeoff weight. He said the trend for thrust-to-weight ratios in modern missiles is downward and initial accelerations of less than

Soviet Tiff

Moscow—Russian Air Force's new official magazine, Sovyetskaya Aviatsiva (Soviet Aviation), has been sharply criticized in the Soviet Army's Krasnaya Zvezda (Red Star) in an apparent rare public display of interservice feuding.

Red Star, the traditional military voice of the USSR, went out of its way to print detailed charges that Soviet Aviation, which is still less than a year old, is poorly edited, frequently inaccurate.

The Army paper published a letter from a Russian Air Force major who said Soviet Aviation failed to identify personnel with their proper units; rejected, cut, garbled or improperly embellished articles received from its correspondents, and attributed imaginary achievements to some officers.

Both Soviet Aviation and Red Star are official newspapers of the Soviet Ministry of Defense.

1.5G are the rule. He said it could be as slow as 1.2G.

"Calling for this low thrust ratio in the preliminary design phase is fraught with danger," he warned, "since unanticipated weight growth might well jeopardize the final product beyond repair."

Solid Propellants

Bossart dismissed the idea that solid propellants will ever be competitive in the larger missile field. High cost, unavoidable combustion chamber weight and handling difficulties will preclude the solids from the larger missiles, he said.

Cost advantage of the oxygen-hydrocarbon combination is difficult to overcome among the liquid propellants, Bossart stated. Unless the cost of high specific impulse propellants comes down several times from what it is today, he said, no economy will result from their use in the first stage of a missile. Only the size, not the cost, would be reduced, he pointed out.

"The so-called super-propellants should, therefore, be reserved for second and third stages of multi-stage vehicles," the Convair official said. "In this case the increased cost of the propellant in the upper stages will be more than compensated by the reduction in size and cost of the first stage."

Bossart suggested that the question of residual propellants is a serious one since unusable propellant left over at burnout would have been payload instead.

He said three primary sources of residual propellants at burnout are:

- **Propellant pumps** requiring too high an inlet pressure. These are unacceptable since they leave a high column of liquid ahead of them at burnout.
- **Rotation of propellants** in the tanks which causes vortexing at the outlets. This can be avoided with suitable baffling.
- **Failure to fill** tanks to the correct levels or deviation of the motor mixture ratio from the required value, causing one of the two propellants to run out before the other. Reliable devices to correct the mixture ratio in flight in order to achieve simultaneous emptying of both tanks are a real challenge, Bossart said.

Structural refinement of large missiles can bring control problems, the Convair engineer noted, pointing out that weight saving cannot be achieved without loss of rigidity. Since higher strength alloys do not have an improved Young's modulus, bending frequencies go down and begin to approach the servo frequency of the missile.

The gyros, of course, cannot distinguish between angles or angular rates due to missile attitude and those due to missile bending deformation. Rate gyros are particularly bothersome.

Gyro Solution

Bossart said the problem generally can be solved by judicious locating of the gyros and by designing the control servos in such a way that they will filter out the undesirable frequencies. If this cannot be done, he said, special rejection filters may be needed.

Propellant sloshing also can have a considerable effect on control, Bossart noted.

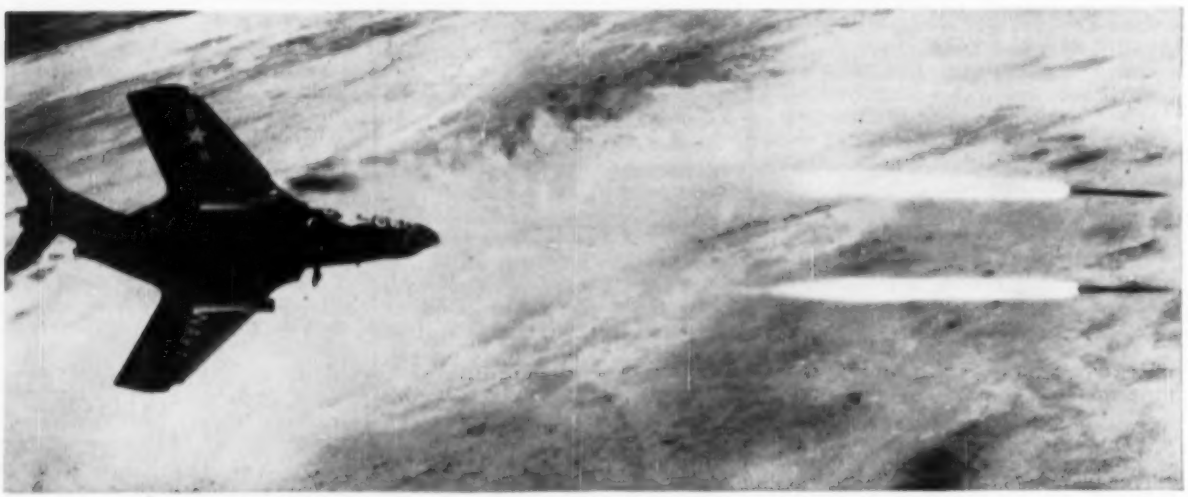
Chief Aerodynamicist W. F. Hilton of Armstrong Whitworth Aircraft proposed a unique solution to the problem of re-entry of manned space vehicles into the earth's atmosphere. He set forth principles of a vehicle designed to protect the crew from heating effects by placing them and other parts of the vehicle in an "aerodynamic vacuum."

Lift Drag Ratio

The vehicle was said to offer maximum drag associated with maximum lift and also to have a low drag at zero lift for initial launching. Since the lift force should be directed towards the earth on re-entry in order to send the trajectory around the earth as much as possible, Hilton said the vehicle would fly upside down by ordinary aircraft standards at all speeds above 5 mi./sec. At this speed it would execute a slow roll to reverse the lift.

He suggested a spin-stabilized circular platform somewhat similar to a "flying saucer," noting that in addition to its low aspect ratio it also offers a good shape for pressurization of the human and electronic payload compartment.

The aerodynamic vacuum would be created by designing the "hot" side of the space vehicle in such a way that it would be impossible for the air flow to turn the corner completely in attempting to fill up the vacuum on the "cold" side of the saucer.



F9F Fires Zuni

Two Navy Zuni 5-in. folding fin air-to-ground Mach 3 rockets are fired by Grumman F9F Cougar (AW Mar. 11, p. 26). Solid propellant Zuni is 9 ft. 2 in. long, has high velocity, can be used as air-to-air weapon against heavy bombers if proper fuzing is used. Navy has awarded Hunter Douglas Division of the Bridgeport Brass Co. a $2 million contract for pilot production of aluminum rocket motor tubes for Zuni. Hunter Douglas worked with Navy Ordnance Test Station engineers to determine that rocket tubes of this type could be made by cold forging process. Hunter Douglas also is making metal parts for motor used in Sidewinder, Navy's infrared guided air-to-air missile. Aircraft can carry up to 48 Zuni rockets in compact, inexpensive launchers.

USAF Fires Atomic Air-to-Air Missile

By Richard Sweeney

Mercury, Nev.—Firing of the first atomic warhead air-to-air missile here ushered in a new era in enemy kill capability for USAF's Air Defense Command, as ADC commander Lt. Gen. Joseph Atkinson disclosed that such missiles already are on operational status at a number of U.S. bases.

While the Douglas MB-1 Genie is not now being flown routinely, Gen. Atkinson said, it has been flown on missions at various ADC stations and, should the need arise, it can be taken from storage, assembled, loaded and made ready for combat within a matter of minutes. Earlier designation of the Genie was Ding Dong.

The missile fired here was a modified version of the solid propellant, free-flight rocket, differing from inventory models in that launch from the aircraft and warhead detonation were accomplished by ground controllers in the Yucca Flat test site control center via a telemeter link. Combat version launching and warhead detonation is a fire control system function. Plane used in the test was an F-89J.

Primary purpose of the shot here was to gain operational data for the Air Defense Command—information on amounts of damage enemy aircraft could be expected to sustain at various distances from the blast and amount of radiation—and to help ADC develop proper plans and techniques for atomic air defense.

Warhead was detonated at slightly more than 18,000 ft. above the test site, exactly over the heads of six observers, five ADC headquarters officers and one AEC civilian, who stood unprotected at Ground Zero to test the potential danger to citizens and property which might lie beneath one of the weapons in combat use.

The MB-1 itself is approximately 100 in. long, nine inches in diameter, has four conventional shaped fins with sloped leading edge, horizontal straight tips and vertical trailing edge for free flight stabilization. USAF officers emphasized that the free flight choice was made to eliminate complexity, increase reliability. On the F-89J, it is carried on Douglas designed and built pylons, substantialness of which indicates the missile is heavier than conventional weapons of same type due to nuclear materials and detonating mechanism.

Propulsion is furnished by Aerojet solid propellant rocket motor which propels missile for some 9,000 ft. in powered flight. On this firing, the missile traveled an approximately equal distance unpowered before the ground controlled warhead detonation. While test officials had announced that the rocket would be detonated between three and five sec. after launch, indications were that flight time was slightly more than three sec. but less than the maximum.

ARROW designates launching point of Genie about 3½ mi. from detonation point, which was at an altitude of about 18,000 ft., proportions of this exclusive Aviation Week photographs taken at the test site indicate. Fireball is in final stage.

Yield kilotons of the weapon was approximately 1½.

Shot was not the first detonation of the MB-1 warhead, which occurred during the 1955 Nevada tests in an air drop and showed that the warhead yield was exactly what Air Defense Command and the Defense Department had requested from AEC. The warhead was developed by AEC's Los Alamos Laboratory.

Ten experiments were conducted during the "John" shot, AEC's name for the rocket detonation, nine of them for military effects for Air Defense Command.

Chances for nondetonation of the warhead or rocket misfire were less than 1%, according to test officials. However, it was acknowledged that, should a warhead fail to detonate in the air during combat, it conceivably could detonate on contact with the ground after a long fall. In addition, fire can set off the nuclear charge, and should an armed aircraft crash land, some seven seconds of fire fighting are allowed and then all personnel are warned to clear the areas immediately.

Air Defense Command expects Genie to expand its capabilities in a number of ways. Possibility exists that a close near miss may set off nuclear or hydrogen weapons being carried by enemy planes. Slightly farther out, and if a nuclear weapon is not carried by the enemy, the target may encounter structural failures, or even farther away, gust loads may cause loss of control or precipitate other problems for attacking

aircraft. In addition, radiation sickness may be caused in an enemy crew, resulting in loss of motor sensory control, vomiting, etc. Enemy crews also may be badly shaken by "mock radiation sickness" as a result of seeing other planes in their attacking force vaporized by hits or close misses.

Air Defense Command is custodian of MB-1s stored at its bases. It has sent its own personnel to AEC for training in handling of nuclear materials as well as handling, assembling and loading of MB-1s. Additional crew training is conducted with models of the rocket at Air Defense Command bases where it is operational. It is planned that practice firings of similar but non-nuclear rockets will be given aircrews.

Although atomic rockets will be the primary plane armament, aircraft will be able to carry GAR type weapons such as Falcons on atomic missions, for backup.

Operationally, the MB-1 will be fired and detonated by Hughes MG-12 fire control systems, a modification of the E-9 used on F-89H aircraft. Although basically intended for lead-collision course attacks, the missile demanded flexibility to use the weapon's capability in attack from any quadrant, and the fire control system modification includes this particular provision.

For the test, and operationally as well, the rocket leaves the ground unarmed in the nuclear sense. Arming and setting of fire control for the Mercury test involved 16 switches. Plane was being flown on autopilot by Capt. Eric Hutchison, with Capt. Alfred Barbee as radar observer and weaponeer, on a course of 280 degrees when launch occurred.

Air Operations

As the missile left the plane, Hutchison initiated a turn using 90 degrees of bank at a 3G acceleration to escape blast. Both aircrewmen said that when the blast reached their aircraft, it produced a "noticeable shock. True airspeed at launch, was 450 mph."

Two other aircraft and crews were in the flight component—one plane for weapons effect study, the other for data collection. The effects plane was piloted by Capt. Alvin Moore, with Lt. Robert Gee as radar observer. Data plane was flown by Lt. Burford Culpepper, with Lt. James Jones as radar observer.

All three planes and crews are assigned to headquarters, Air Defense Command, Ent AFB, Colorado Springs, Colo. Assembling and loading of the rocket was performed by Lt. Don K. Sykes, also of Air Defense Command.

Air operations for the test, which involved 25 aircraft, were mounted from Indian Springs AFB, which is under the 4950th Test Group (Nuclear), Kirtland AFB, N. M. It was from this base that five rockets similar to the MB-1 were fired in practice before the nuclear test, with high explosive warheads.

Currently, the F-89J is the only aircraft capable of mounting atomic missions, although the pylon can be mounted on a wide variety of planes and fire control systems modified to accommodate the nuclear rocket. In addition, the F-89 flown in the test had solid wing tip tanks, indicating that former folding fin aircraft rocket installation has been abandoned and the space turned over to additional fuel for longer range.

Also, AVIATION WEEK has learned, the external fuel tank fittings being designed for Convair's F-102A interceptor, will accommodate the Douglas MB-1 pylon, giving that plane an atomic capability. On the F-106 interceptor, the MB-1 will be carried internally for primary armament.

McDonnell's F-101 also has been billed as having atomic capability, although no flights have yet been conducted in this area.

INFRARED guided Hughes Falcon.

Infrared-Guided Hughes Falcon Increases ADC Kill Potential

Washington—Hughes GAR-2A Falcon missile with infrared guidance is now operational with Air Defense Command and has been fired from F-89Hs, F-101Bs and F-102As.

Kill probability for all-weather interceptors armed with a mix of radar-guided and infrared guided Falcons is approximately 80 to 90%, Air Force spokesman said. Pilot selects the type of guidance to fit the situation.

Infrared gives interceptors increased low-altitude capability and complicates an enemy's countermeasures problem. Field checkout for the GAR-2A requires only an elemental light device to determine whether the infrared "eye" is functioning properly.

Results of 50 to 100 tests against 10 to 12 TM-61 Matadors, five to seven QF-80 drone fighters, air-launched rockets similar to Sidewinder and parachutes and balloons were "very good," USAF said. Hughes Aircraft Co. Vice President Roy E. Wendahl, manager of the Tucson plant where the Falcon is manufactured, said test results were better for the 2A than for the GAR-1 radar-guided Falcon at the comparable stage of development. Development of the infrared guidance has been under way since about 1952.

Seeking accuracy is "a little better" than with the radar model, and unit cost is about $9,000—less than that for the GAR-1D.

Falcons are fired in salvo, and radar and infrared types could be mixed if the situation called for it. In test firings against Matadors at Holloman Air Development Center, Holloman AFB, N. M., salvos of three to six were used. Films shown at a Pentagon press conference recorded a triple hit by a salvo of three against a Matador and same score against a QB-17 (see page 37).

Use of salvos results from a set of engineering compromises between the engineering complexities in the Hughes fire control system and the missile itself. USAF at no time considered using a single Falcon against a target, an Air Force spokesman said.

Range of the GAR-2A after launch from the interceptor is "something in excess of five miles," USAF said. Like other Falcon models, it can be fired in climb before the target is in sight.

Hughes fire control systems, carried on all USAF and RCAF all-weather

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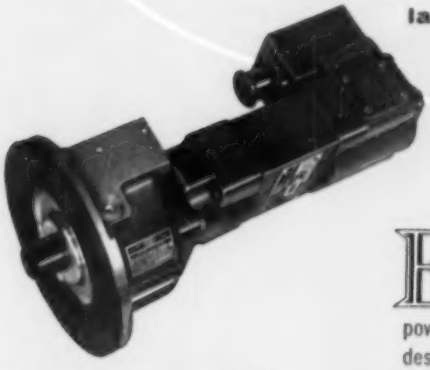

Type: D-925 Rotary Actuator for Missile Fin. **Output:** 400 inch-pounds @ 64 RPM, 24 volts, 27 amps. **Duty Cycle:** 1 minute on, 10 minutes off; **Gear Reduction:** 135 to 1 in 2.25" length; **Weight:** 6.75 lbs. **Meets Mil. Specs.:** MIL-A-8064 for actuators, MIL-M-8609 for motors.

Type: D-818 Leading Edge Flap Actuator; **Weight:** 20.5 lbs. **Normal Operating Load:** 6,000 lbs.; **Maximum Operating Load:** 12,000 lbs. **Ultimate Static Load:** 24,000 lbs.; **Stroke:** 3.15"; **Rate of Travel:** .33" per second; **Amperes:** 3 amps at 480 cycles on 200 volts at the 6,000 lbs. load. **Meets Mil. Specs.:** MIL-A-8064 for actuators, MIL-M-7969A for motors.

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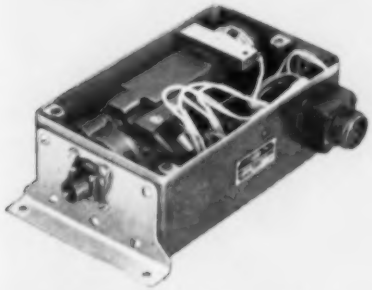
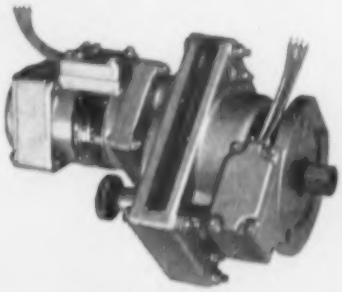
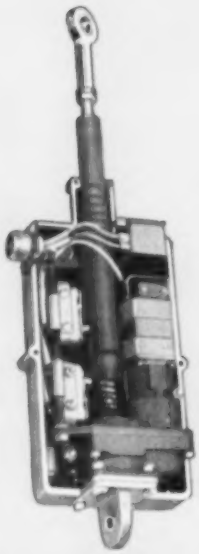


Type: D-892 Power Package; **Size:** 7¼" x 4¾" x 2¾". **Output:** 28 volts D.C., 1390 RPM at take-off shaft, 18 inch-oz. torque. **Weight:** 3¾ lbs.; Operative in ambient temperatures to 250° F. **Meets Military Specifications:** MIL-A-8064 for actuators, MIL-M-8609 for motors.



Type: D-868 Rotary Actuator; **Weight:** 9⅛ lbs. **Power:** 200 volt, 400 cycle, 3-phase motor. **Ambient Temperature Range:** −65°F. to +400°F.; **Shaft Torque Limit:** Adjustable. **Load:** 1,650 inch-lbs. maximum to approx. 2 RPM on 1.5 amps. **Meets Military Specifications:** MIL-E-7894 and MIL-A-8064.



Type: D-607 Transport Door Actuator; **Weight:** 4.5 lbs. **Stroke:** 6.25"; **Operating Load:** 450 lbs.; **Ultimate Static Load:** 7150 lbs. tension; **Speed of Stroke:** under 450 lb. load—0.3" per second. **Size of Power Section:** 2¼" x 4½" x 8⅛". **Meets Mil. Specs.:** MIL-A-8064 for actuators, MIL-M-8609 for motors.

Type: D-822 Trailing Edge Flap Rotary Actuator; **Weight:** 35 lbs. **Normal Operating Load:** 26,000 inch-lbs. **Maximum Operating Load:** 52,000 inch-lbs. **Ultimate Static Load:** 75,000 inch-lbs.; **Travel:** 45 degrees at .625 RPM; **Amperes:** 4 amps at 26,000 inch-lbs. at 480 cycles on 200 volts. **Frequency Range:** 380 to 420 cycles. **Meets Mil. Specs.:** MIL-A-8064 for actuators, MIL-M-7969A.

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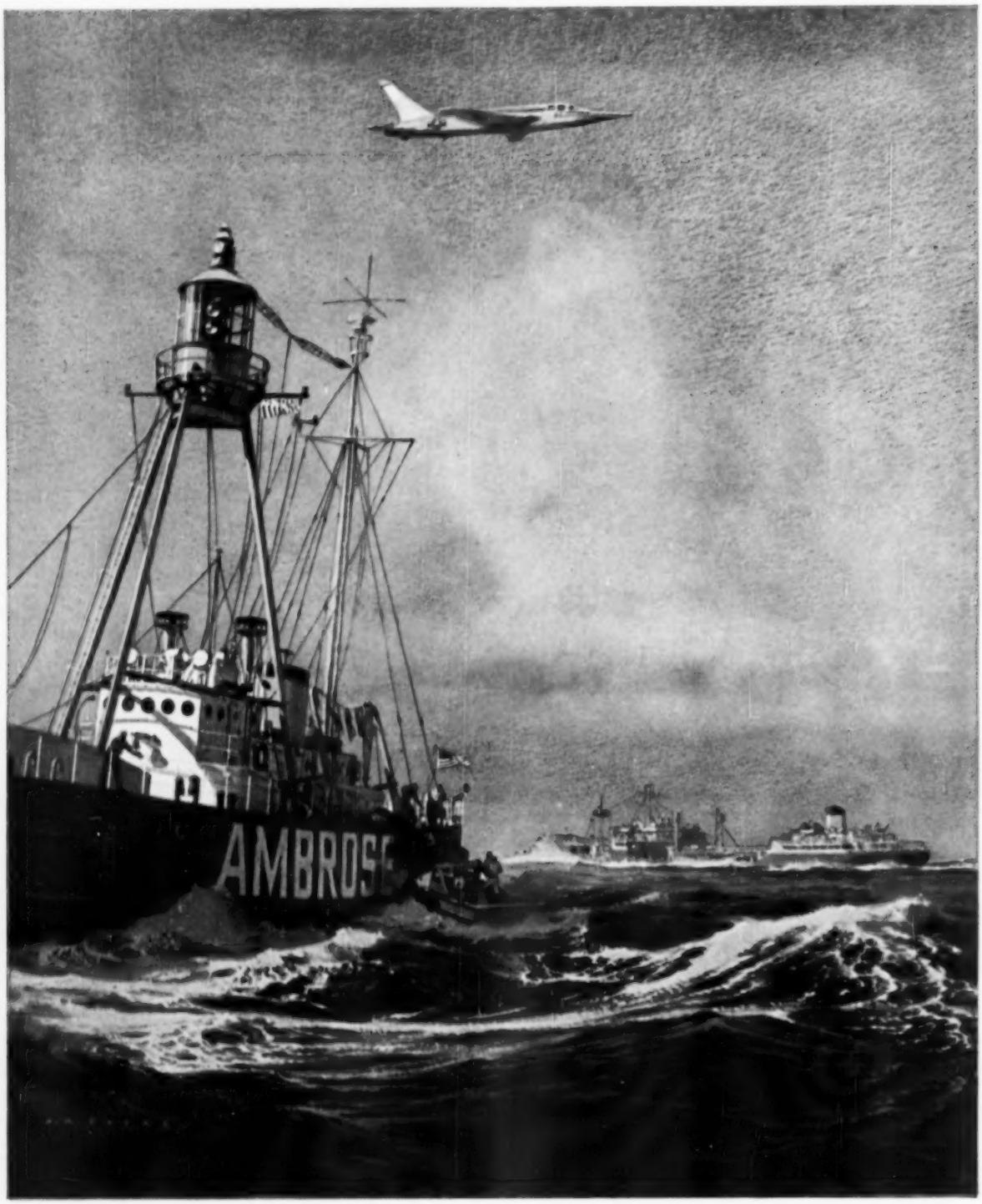

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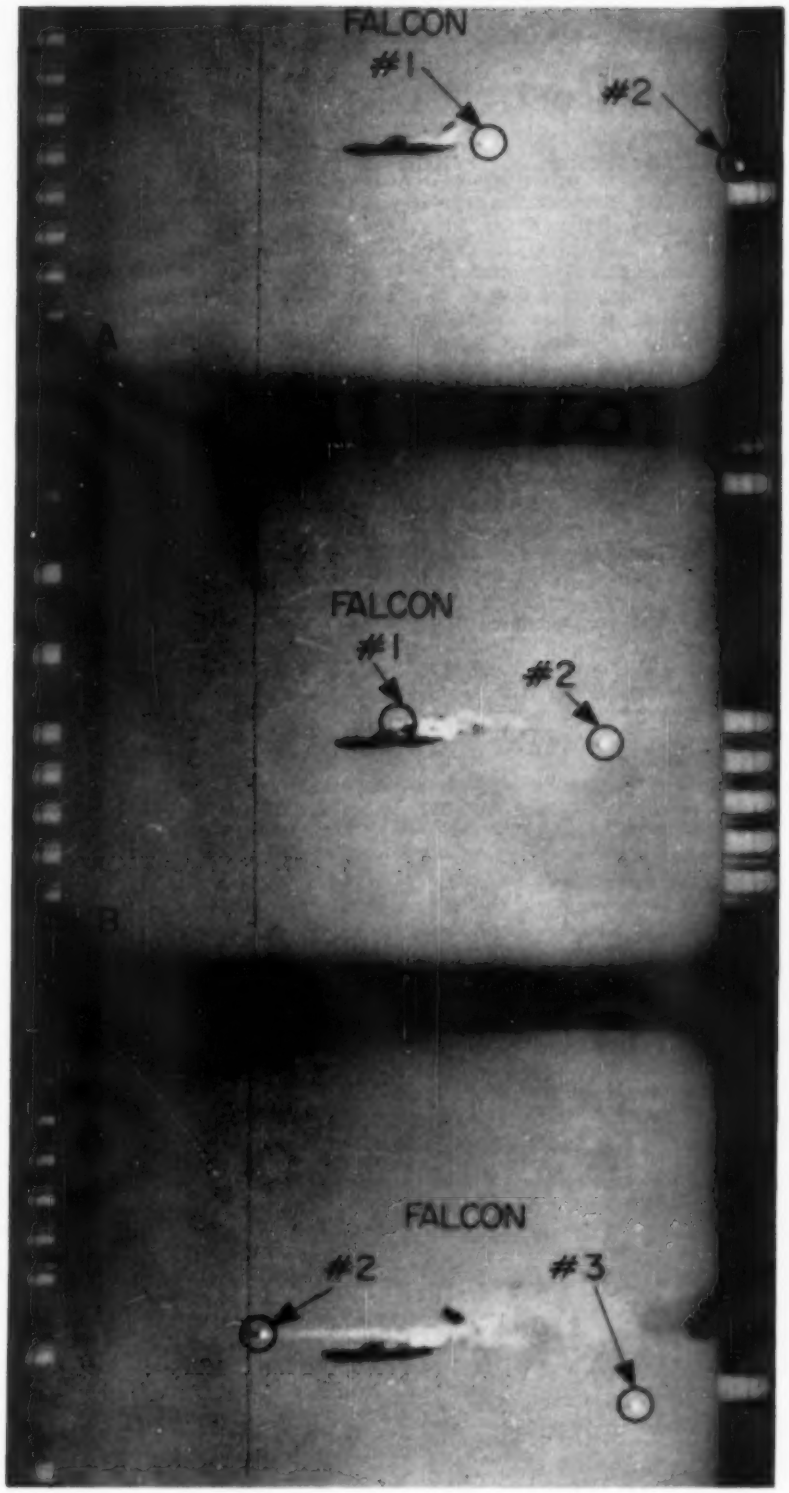


TWO GAR-2A Falcons of a salvo of three fired from a Convair F-102A in USAF test at Holloman Air Development Center, N. M., strike a Martin TM-61A pilotless bomber. First Falcon is a split second from impact in top photo of sequence. Second photo shows actual impact of first Falcon on tail of Matador with second Falcon about to follow. Second Falcon has knocked off piece of Matador in bottom photo and the last Falcon is approaching the target. Infrared guided Falcons and radar guided types can be mixed on aircraft if necessary. Range of GAR-2A is more than five miles from launch.

interceptors, slave the GAR-2As to the target before launch. "Wide-look" angle of the infrared eye permits launching from far to any side of the target, eliminating the necessity for tail attacks.

GAR-2D is not directly competitive with Navy-developed Philco Sidewinder, which USAF has ordered for use in Air Defense Command on the F-104 Starfighter. Sidewinder was described as a simpler, less expensive infrared missile for use with dayfighters and Falcon as a more sophisticated infrared system for internal or semi-submerged (F-101B) storage on all-weather interceptors armed with more versatile fire-control systems.

Infrared Falcon is six and one-half ft. long, six and one-half in. in diameter and weighs slightly over 120 lb.—almost the same dimensions as the GAR-1 and 1D.

Infrared nose is only difference between 1D and 2A.

Shipping container for GAR-2A carries these stencilled instructions: "Avoid direct solar radiation," and "In transit temperature limits 40F to 110F."

Red Dean Missile Revealed by British

London—Existence of Red Dean, a new Vickers-Armstrongs air-to-air missile was revealed by the Society of British Aircraft Constructors in a list of missiles to be on display at the SBAC Farnborough exhibition in September. Vickers gave no further details.

SBAC said security restrictions have been lifted sufficiently to enable the British industry to demonstrate for the first time a "sizable" amount of its work in the missile field.

There will be a special guided missile enclosure at the exhibition. In addition to the Red Dean, missiles on display will include:

- **De Havilland Firestreak,** an air-to-air infrared missile which is to be fitted to the Gloster Javelin, English Electric P.1 and de Havilland Sea Vixen.
- **Bristol Bloodhound** ground-to-air weapon ordered by the Royal Air Force.
- **English Electric Thunderbird** on order by anti-aircraft command and under development for RAF.
- **Armstrong Whitworth Sea Slug** ship-to-air missile, ordered by the Royal Navy.
- **Fairey Fireflash,** RAF air-to-air training missile.

Test and target missiles to be displayed include the Bristol Bobbin, Bristol Borzoi, and Australian Jindivik powered by an Armstrong Siddeley Viper.

Aircraft taking part in the Farnborough show will include the English Electric P.1A and P.1B, the Fairey Delta II, and possibly the Saunders Roe SR.53 rocket-jet interceptor.

Hurley Offers House Committee Stronger Industry at Less Cost

By Katherine Johnsen

Washington—Roy T. Hurley, chairman and president of Curtiss-Wright Corp., has volunteered to serve as a congressional consultant to blueprint a plan for a sturdy aircraft industry and, at the same time, "save hundreds of millions of dollars."

Hurley made his offer to the House Armed Services Investigating Subcommittee at the opening sessions of the group's investigation into profits and procurement policies of 17 aircraft engine manufacturers (AW April 1, p.26). The three main points of the plan, Hurley said, would be to:

- **Increase profits.**
- **Increase company-owned** facilities.
- **Give military procurement** officials "more freedom of action" in the use of funds and then hold them accountable for "the end result."

Major Savings

These three inter-related steps, Hurley emphasized, would pave the way for savings in the major area where it is possible to make them—costs. "For Curtiss-Wright," he said, "cost averages about 96.25% of the price of the engine.

"A 5% reduction of this amount would be a greater saving for the taxpayer than completely eliminating all profits on military business. In the world of business and government today, too much emphasis is being placed on profits and not enough on cost reduction. It is easy to talk about profits, it is a popular subject. But, it does not require the work and know-how that goes into well-planned cost reduction programs. . . ."

Hurley challenged the present policy of "an Air Force in being—that is becoming obsolete by hours—and the theory that we do not need an industry to support it."

He also protested that "we are now returning to the position of having 70% of the military engine capacity in one company (Pratt & Whitney Aircraft). Some day when an emergency again occurs, we will be unable to supply the engines needed, and the engines will lack the progress that is the natural result of competition."

Since the government can only furnish facilities after contracts have been awarded, Hurley complained that "they are always late and invariably cause upsets in delivery schedules of important procurement." He reported that it took Curtiss-Wright seven years to finally get a government-furnished big extrusion press into operation at its Buffalo plant because of "delays, holdups, investigations and reinvestigations and requests for innumerable reports and conferences."

If manufacturers were permitted sufficient profits to supply their own up-to-date facilities, Hurley maintained, "a superior product at a lower cost" would result.

In reply to a subcommittee questionnaire, Curtiss-Wright reported for the five-year period, Jan., 1952, to Dec. 31, 1956:

- **Net worth** of the corporation increased from $121 million to $183 million.
- **Total government** business increased from $274 million in 1952 to $403 million in 1956.
- **Total dividends paid** mounted from $6.1 million in 1952 to $19.6 million in 1956. For the years between, the dividends paid totalled—1953, $6.1 million; 1954, $8.9 million; 1955, $14.1 million.
- **Contributions or dues paid** to trade, professional or promotional organizations by the corporation increased from $69,719 in 1952 to $116,298 in 1956. The largest payment in each year was to Aircraft Industries Assn.—1952, $55,863; 1953, $56,169; 1954, $53,-103; 1955, $64,542; 1956, $83,451.

Wright Aeronautical

The government business of Curtiss-Wright's Wright Aeronautical Division for the five-year period was reported:

- **Engine contracts** totalled $1.6 billion, on which payments of $1.4 billion were received by the end of 1956. Profits averaged 3.82%.
- **Research and development contracts** totalled $146.6 million, with payments received totalling $94.8 million.
- **Spare parts, overhaul, service** and repair contracts totalled $411.8 million for the five years; payments received amounted to $247.6 million.

Meanwhile, Air Force Secretary James H. Douglas defended a controversial contract to Curtiss-Wright for the overhaul of 500 J47 engines at the Utica, Mich., plant of Studebaker-Packard which Curtiss-Wright leased as being "sound at the time it was made" (AW Aug. 13, p. 26).

Rep. William Hess (R.-Ohio), ranking minority member of the subcommittee, has repeatedly criticized USAF for letting the contract in July, 1956, at a time when it was clear that the J47 overhaul workload would be curtailed and that the engine would be phased-out. The overhauls already were being performed at two USAF bases and at the Evendale, Ohio, plant of General Electric Co. The Curtiss-Wright contract ultimately resulted in a cutback at the General Electric plant.

At the time of the Curtiss-Wright contract, Douglas said it appeared that the facilities of the two USAF depots and the General Electric plant would be required for other overhaul projects and that this "contributed to the justification for another J47 facility." He added:

"B-52, KC-135, F-101 and F-100 aircraft production was at a maximum, portending large-scale J57 engine overhaul at the USAF depots which also overhaul J47 engines. At the same time, the B-58, F-104 and RF-104 production outlook indicated a buildup of General Electric-built J79 engines. . . ."

However, because of cutbacks and stretchouts in the aircraft programs, Douglas said, "our overhaul planning . . . for the engines exceeded the requirements. This situation was accentuated by flying hour program reductions. . . ."

Overhaul Costs

The unit cost on overhaul of 3,657 engines at the General Electric plant during fiscal 1957 was $5,496, Douglas reported. He said the unit cost on the 300 overhauls Curtiss-Wright completed during Fiscal 1957 was first 100, $15,046; second 100, $7,700; final 100, $6,874. He anticipated that the quotations of the two firms for Fiscal 1958 overhauls "will be competitive at approximately $6,500 per engine." Douglas told the subcommittee that Air Materiel Command has been notified that follow-on contracts to the Utica facility are to be based upon its "ability to attain a competitive position and provide satisfactory performance."

Rep. Edward Hebert (D. La.), chairman of the subcommittee, has charged that USAF was "coerced" to let the Curtiss-Wright contract in order to "bail out" Studebaker-Packard and that the shift in business from General Electric has cost $25 million (AW July 22, p. 25). Hurley declared that this "came as a complete surprise." He has been furnished USAF records to review Air Force costs involved in the transaction. Several subcommittee members challenged him to substantiate his charge.

Hurley was requested by Hebert to furnish data on all other government business that has been let to Studebaker-Packard since Curtiss-Wright moved to aid the financially ailing firm.

Hurley said Curtiss-Wright "has invested $35 million of its own funds and has been successful in meeting both the government and public requirements for the successful continuation of Studebaker-Packard in the industry."

Gen. Baker Assumes Capital Presidency

Carmichael will direct policy as board chairman; financial expert Baker plans tighter economy.

By L. L. Doty

Washington—In a surprise action, Capital Airlines' board of directors last week elevated J. H. Carmichael to chairman of the board and elected USAF Maj. Gen. David H. Baker to replace him as president and chief executive of the company.

The new president, whose retirement from the Air Force was announced earlier this month, was former director of procurement and production for the Air Materiel Command (AW July 8, p.25). Described as a "great challenge man," Gen. Baker has had a long career as a financial and procurement expert. His Air Force retirement becomes official on Wednesday; he will join Capital the following day.

Under the new arrangement, Carmichael will handle all policy matters of the company, and Gen. Baker will direct all activities pertaining to the operation of the airline. A company spokesman told AVIATION WEEK that the change in no way reduces Carmichael's role as directing head of the airline.

He said the move was made to strengthen management and expand the organizational structure of Capital to meet the problems of the jet age.

Carmichael Succeeds Hann

Carmichael will succeed the present chairman, George R. Hann, who was elected chairman of the executive committee of the Board. Hann has been long associated with Capital as one of the company's major stockholders. He replaces Charles Murchison who will remain a member of the board and legal counsel for the airline.

The airline contemplates no immediate change in its present equipment program, although plans to augment its present fleet of 59 Viscounts by an additional 15 have been dropped, and the order for 14 turbojet de Havilland Comets has been deferred (AW May 13, p.39).

Capital still intends to reinstate the Comet order once its current financial difficulties are alleviated and arrangements for additional financing involving a $60 million bank loan can be completed. One of the primary purposes of the management reorganization is to bring the company's shaky financial structure into a more stable position.

Last month, the airline revised its 1957 earnings estimate downward from an earlier prediction of a $2.1 million net profit to an estimated $2.5 million loss. Traffic and revenues have shown a spectacular rise since the introduction of the Viscounts, but heavy interest expenses; mounting costs, which are generally plaguing the airline industry, and transitional expenses caused an operating loss of $2,801,052 and a net loss of $1,256,953 in 1956.

An improvement toward economic stability became apparent during the first five months of 1957, however, with the airline cutting its operating loss by close to one-half as a result of increased revenues.

In May, the airline reported a net profit of $160,000 for the month after interest charges of $321,736 as compared with a net loss of $244,016 in May, 1956 after interest charges of $108,654.

Equipment Purchase Notes

Operating revenues for the month increased to $8.3 million, a 55.3% increase over the previous May. Operating expenses were $7.8 million or 42% higher than expenses during May, 1956. Depreciation expenses related to the Viscounts delivered since May, 1956, accounted for $453,211 of the $2.3 million increase in operating expenses.

Nevertheless, the airline's breakeven load factor has shown a sharp rise and expenses must be brought into a closer alignment with revenues before Capital can undertake a major refinancing program. Equipment purchase notes were issued under contracts covering the original order of 60 Viscounts and related items at the time of their delivery. Such notes are payable in British pounds and have been recorded at the conversion rate of $2.80 per pound. They are payable in monthly installments over a period of five years and bear interest at 1¾% above the Bank of England interest rate ruling at the date of payment. The interest rate is not to exceed 6¼%, the amount the airline is now paying.

Viscount Defended

Last year, the airline borrowed $12 million through the issuance of 4½% convertible subordinated debentures to finance the expanded operations of the company. At that time, the authorized common stock was increased from one million shares to two and one-half million. Later attempts to negotiate a $60 million bank loan to finance new equipment failed to materialize.

Carmichael has strongly defended the Viscount and has repeatedly said that the heavy losses incurred by the operation of the company's DC-3s, DC-4s and Constellation 049s are offsetting the profits earned by the Viscount.

The airline, however, has recognized the need for a larger, faster aircraft to compete with the Lockheed Electra turboprop late in 1958 or early 1959 on its Chicago-Washington, New York-Chicago and New York-New Orleans routes. Both Eastern and American

Fares Increase Setback

Washington—Disapproval of the 6% passenger fare increase asked by seven U.S. trunk airlines was recommended last week by the Civil Aeronautics Board Bureau of Air Operations.

In a brief to the Board, the Bureau Counsel said none of the seven carriers has shown that its present and prospective earnings—when judged by the standards of the Civil Aeronautics Act—are such as to require an interim increase in fares pending determination of the issues in the General Passenger Fare Investigation. The Bureau Counsel added that an analysis of economic considerations shows that the carriers still enjoy an economic opportunity to achieve favorable earnings and, therefore, the Board should deny the proposed increase.

The seven carriers applied for a 6% increase on the basis that profits were dwindling because operating costs were increasing at a greater rate than operating income. Airlines contend that the industry could be irreparably damaged if the level of earnings continues to drop while traffic continues to increase.

Airlines petitioning for the increase are United, Northwest, Braniff, Capital, Eastern, Delta and Trans World Airlines. The Board has scheduled oral arguments on the case for Wednesday.

Airlines who compete with Capital have ordered the Electra.

Carmichael announced the purchase of 20 Viscounts in 1954. The order was later increased to 60, and the turboprop service was inaugurated in July of 1955. The move was taken primarily to strengthen Capital's competitive position against the Constellation 1049Gs, DC-6Bs and DC-7s that had been introduced on routes paralleling Capital's more profitable route segments.

The airline's route structure was substantially improved in 1955 with the addition of several new routes by the Civil Aeronautics Board and the lifting of certain operating restrictions on its established routes.

Carmichael, however, has termed the present route pattern the "curse" of Capital Airlines and is pursuing a vigorous program designed to obtain operating routes from Detroit to Florida in an attempt to introduce a long-haul, high density traffic segment to the airline's system. One airline spokesman described Capital as the "largest feeder-line in the industry" and said longer routes must be added to the overall pattern if consistent net profits are to be realized.

Carmichael was elected president of the company in 1948 when the airline was threatened with bankruptcy. By introducing an austere economy program, he was able to move the company into a strong financial condition within two years. A former airline pilot, Carmichael has been associated with Capital and its predecessor company in a managerial capacity since 1936.

The route expansion and refinancing programs will fall under the direction of Carmichael as board chairman, while Gen. Baker will be charged with bringing about more efficiency and stronger economic control of the airline in its "day-to-day operations." Gen. Baker is an exponent of efficient management and a disciple of Harvard Business School principles.

He is 49 years old and a graduate of West Point. He was graduated from the Air Corps primary and advanced flying schools in March, 1932, and flew the air mail between Newark and Cleveland at the time the air mail contracts with private carriers were cancelled in 1934.

He was graduated from the Harvard School of Business in 1941. His World War II service included duty as commander of the Ninth Air Force Service Command and in 1946 he was named to the faculty of the National War College in Washington.

Later, he was senior Air Force member of the Joint Logistics Plans Group in the Office of the Joint Chiefs of Staff. Before his retirement from the Air Force, he served as director of procurement and production of the Air Materiel Command. He is generally credited as the officer who correctly warned the industry a year ago that readjustments in facilities and programming would be required to meet the shift in emphasis from manned aircraft to missile production.

In a statement to Capital's employes, Carmichael said, "Having known Gen. Baker for several years, I know you will share in my conviction that his election marks another forward step by Capital and significantly strengthens the Capital organization for the task that lies ahead."

Infrared Proximity Detector Set for Early Flight Test

Los Angeles—Aircraft proximity warning indicators which use infrared, ultraviolet or nuclear energy were some of the new proposals considered here last week by airline representatives attending an Air Transport Association sponsored meeting on the air collision problem. The new systems include:

• **Infrared:** Aerojet-General described a 30 lb. (uninstalled weight) self-contained PWI which it believes can detect and display position of other aircraft at ranges of 2-4 miles, depending upon aircraft type and atmospheric conditions. System consists of a small IR scanner for 360-degree azimuth coverage at airplane's own altitude, plus two passive IR dectectors which provide upper and lower hemisphere protection.

Aerojet-General hopes to flight test prototype system within six months.

• **Ultraviolet:** Sylvania Electric, which has been studying ultraviolet techniques, suggested the possibility of a cooperative type PWI and collision avoidance system. Each aircraft would carry a directional ultraviolet interrogator and an omnidirectional ultraviolet source. When interrogation was received from a nearby airplane, ultraviolet beacon would reply in pulsed code giving altitude, course, speed, and rate of climb for use in collision avoidance computer. Sylvania says ultraviolet is not subject to background noises which can produce false alarms with infrared system at altitudes under 40,000 ft.

• **Nuclear:** Aviation Instruments Manufacturing Co. suggested the possibility of cooperative PWI in which neutron emitting source is installed in aircraft tail together with nuclear radiation detector for spotting radiation from nearby aircraft. Neutron emitter's low cost would permit installation on light planes not equipped with radiation detector, giving protection against fully equipped aircraft. Detection ranges of several miles appear feasible, but company has made only preliminary studies pending evaluation of industry interest.

Radio Corp. of America reported results of its study of the possibility of using existing weather radars for PWI purposes. Modification of video circuitry, use of suitable operational techniques provides some protection but falls short of ideal PWI goals set by ATA and the military, RCA said.

Service to Mexico Begun by Eastern

Mexico City—Eastern Air Lines last week made its first scheduled appearance here, 11 years after first receiving U.S. authority to make the flight.

Using Douglas DC-7Bs, Eastern inaugurated once-a-day flights from New York to Mexico City and Mexico City to New York with mandatory stops in New Orleans. Scheduled total elapsed time for the flight is seven hours, 50 min., including a one-hour, 15-min. layover in New Orleans.

The airline first received U. S. authority for the route in 1946. The authority was later revoked by President Truman and then reinstated by President Eisenhower after the signing of the Mexican bilateral agreement in March (AW March 18, p. 45).

The airline's scheduled competitor over the route is Aeronaves de Mexico, which hopes to begin service by the middle of August if it can lease the necessary equipment—probably Lockheed Super Constellations.

Aeronaves also has been designated to fly the New York, Washington-Mexico City nonstop route granted under the bilateral. It plans to begin service over this route sometime this fall with the first two of five Bristol Britannia turboprop transports it has on order.

Eastern also may be Aeronaves' competitor on this run. Eastern and Pan American World Airways have been waging a vigorous battle for the route, but airline officials here and in Washington last week were giving Eastern the inside track. Civil Aeronautics Board's recommendations in the case were at the White House late last week for final approval.

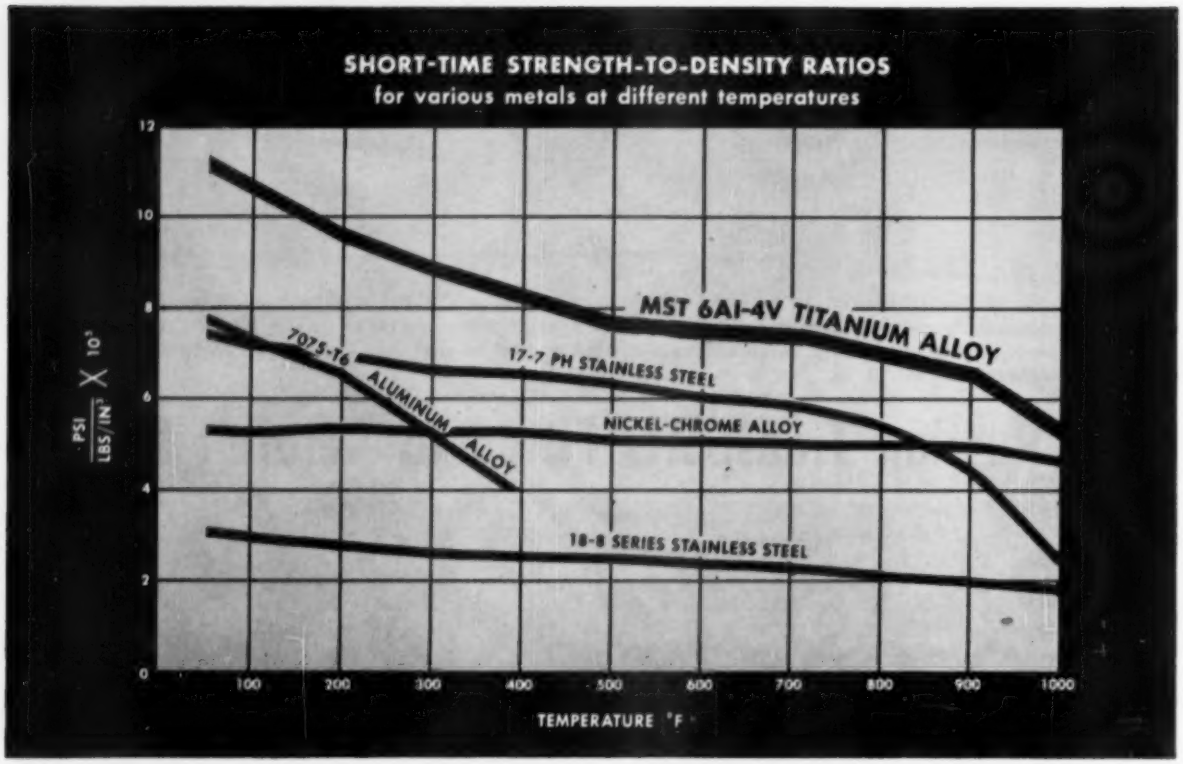
First U.S. line to begin service here under the bilateral agreement was Western Air Lines. Western inaugurated once-a-day roundtrip flights into the capital on July 15.

MOSCOW IL-18 turboprop transport designed by Sergei Ilyushin has long strake antenna on top of fuselage, relatively thin wing and special glass panels on top and at both sides of the cockpit for good visibility when maneuvering. Plane will be produced in plant on the edge of Moscow's Central Airport.

New Russian Transports Fitted to Aeroflot Needs

HEAD ON VIEW of AN-10 Ukraina shows drag profile during display at Moscow's Vnukovo Airport. Ukraina is designed specially for operations on the unimproved grass fields that are the main civil airports for many cities in Aeroflot's route pattern. Note thick wing root sections used for fuel storage.

SIZE of Ukraina designed by O. K. Antonov is shown in contrast to Aeroflot employes standing near the nose and tail. Note the visibility panels on the top and sides of the cockpit, external power source connection just aft of main landing gear and the ventral fin under the rear fuselage.



TITANIUM ON TOP

in medium-high temperature range

Today's most popular titanium alloy, MST 6Al-4V, excels all other metals in strength to density ratio through 900°F. At room temperature, considering only strength, a part made of this alloy need have only 60% of the weight of the equivalent part in stainless steel.

Performance for extended times at elevated temperatures is likewise good. In typical creep tests, with 1% permanent deformation allowed, MST 6Al-4V alloy shows 100,000 psi allowable stress at 750°F for 1 hour; 77,000 psi at 100 hours; 65,000 psi at 1000 hours.

Meanwhile new alloys extending the elevated temperature usefulness of titanium—to as high as 1000°F—are now emerging from the laboratory into production.

Write Dept. B-7, for copy of "Titanium Alloy Properties"

SELECTION GUIDE TO MST ALLOYS

Typical Mechanical Properties of Annealed Titanium and its Alloys

	Form	Ultimate Tensile Strength, psi	Yield Strength, psi	Elongation % *
COMMERCIALLY PURE TITANIUM				
MST Grade III	Sheet, Bar	70,000	50,000	25
(3 different strength levels)	Sheet, Bar	85,000	65,000	23
	Sheet, Bar	100,000	80,000	20
TITANIUM ALLOYS				
MST 6Al-4V				
Annealed	Bar	140,000	130,000	15
Age hardened (1)	Bar	165,000	155,000	12
Age hardened (2)	Bar	180,000	165,000	10
Annealed	Sheet	140,000	125,000	12
MST 3Al-8Cr	Bar	155,000	145,000	13
MST 4Al-4Mn	Bar	150,000	140,000	14
MST 8 Mn	Sheet	137,000	125,000	16

(1) 1650°F—1 hour—WQ; 1100°F—2 hours—AC
(2) 1700°F—1 hour—WQ; 1000°F—8 hours—AC

WQ—Water Quench
AC—Air Cool

* Values for 1" on bar and 2" on sheet

MALLORY Ti SHARON

MALLORY-SHARON TITANIUM CORPORATION · NILES, OHIO

Producers of titanium and titanium alloy sheet, strip, plate, rod, bar, billets

New Civil Air Regulation Sets Rules for Turbine Transports

By Ford Eastman

Washington—Special Civil Air Regulation establishing design and performance requirements for jet and turboprop transports was adopted last week by the Civil Aeronautics Board.

CAB said performance requirements now in effect were first established almost 12 years ago and are not suitable for direct application to turbine-powered aircraft. The higher speeds and altitudes, as well as certain inherent characteristics of turbine engines, have introduced numerous new technical and design problems that necessitated re-evaluation and amendment of many of the provisions, the CAB said.

The new regulations are applicable to aircraft now nearing completion at manufacturing plants in this country and abroad. Included in this category are the Boeing 707, Douglas DC-8, Lockheed Electra, Convair 880, Fairchild F-27, Sud Aviation's Caravelle, Vickers Viscount, Bristol Britannia and de Havilland Comet.

New Temperature Ruling

One of the significant changes between present and new special regulations is the introduction of full temperature accountability in all stages of performance except the landing distances required.

CAB said the introduction of full temperature accountability will insure that the airplane's performance is satisfactory irrespective of the existing atmospheric temperature. Performance requirements heretofore applicable did not give sufficient assurance in this respect, the Board added.

The reason for omitting the direct application of temperature accountability in the requirement for landing distances, the CAB explained, is that this stage of performance always has been treated in a fashion whereby temperature effects are taken into account indirectly, together with the effects of other operational factors. Long-range studies on rationalization of airplane performance have not yet yielded a satisfactory solution to the landing stage of performance. The Board hopes, however, that continued studies will result in a solution of this problem.

Introduction of full temperature accountability has necessitated a complete re-evaluation of the minimum climb requirements. Since the prescribed climb must now be met at all temperatures rather than be associated with standard temperature, the specific values of climb have been altered.

In each instance, the change has been in the downward direction because, although the previous values were related to standard temperature, a satisfactory resultant climb performance was attained at temperatures substantially above standard.

While values of minimum climb performance specified in the new code will tend to increase the maximum certificated weights of the airplane for the lower range of temperatures, they will limit these weights for the upper range of temperatures, giving assurance of satisfactory climb performance at all temperatures.

Minimum Climb

In considering the various stages of flight where minimum values of climb have been established heretofore, the Board found that in two of the stages —all-engine-operating en route and one-engine-inoperative en route—the establishment of minimum values of climb is unnecessary. The reason, the CAB said, is that, in the case of the all-engine-operating stage, it has been found not to be critical and, in the case of one-engine-inoperative stage, it is now more effectively covered by the en route performance operating limitations.

Since minimum climbs prescribed primarily affect the maximum certificated weights of the airplane and not the maximum operating weights, the Board has placed emphasis upon the ability of the aircraft to clear obstacles on takeoff and during flight. To this end, criteria for the takeoff path, en route flight paths and transition from takeoff to the en route stage have been prescribed to reflect realistic operating procedures.

Temperature is accounted for in establishing all flight paths, and an expanding clearance between the takeoff path and the terrain or obstacles is required until the en route stage of flight is reached.

In order to insure that the objectives of the prescribed performance are realized in actual operations, the Board said the manufacturer will be required to establish procedures to be followed in the operation of the plane in the various conditions specified by the regulation. These procedures, each designed for a specific airplane, will permit the operator to utilize the full performance capabilities of the transport more readily than if the regulations prescribed all-inclusive procedures.

The new performance requirements establish more clearly than before performance limitations that are conditions on the airworthiness certificate of the airplane. In addition to the maximum certificated takeoff and landing weights, limitations on the takeoff distances and on the use of the airplane within the ranges of operational variables, such as altitude, temperature and wind, are included. Since these limitations are in the airworthiness certificate they are applicable to all type operations conducted with the aircraft.

In adopting the code the CAB said the new performance requirements contained were based on the best information presently available. It added, however, that, due to the present limited operating experience with turbine-powered transport airplanes, improvement in the requirements can be expected as a result of the direct application of the code.

CAB Upholds CAA; Cancels Specht License

Washington—Revocation of the airline transport pilot rating of Leonard J. Specht, Trans World Airlines captain, was voted by the Civil Aeronautics Board last week. The Board's action over-ruled the hearing examiner who recommended a six-month suspension and upheld the Civil Aeronautics Administration which asked revocation.

The action does not affect Specht's commercial rating which will permit the captain to fly as a co-pilot or to be employed in any capacity other than captain. After a period of one year Specht can apply for a new airline transport pilot rating.

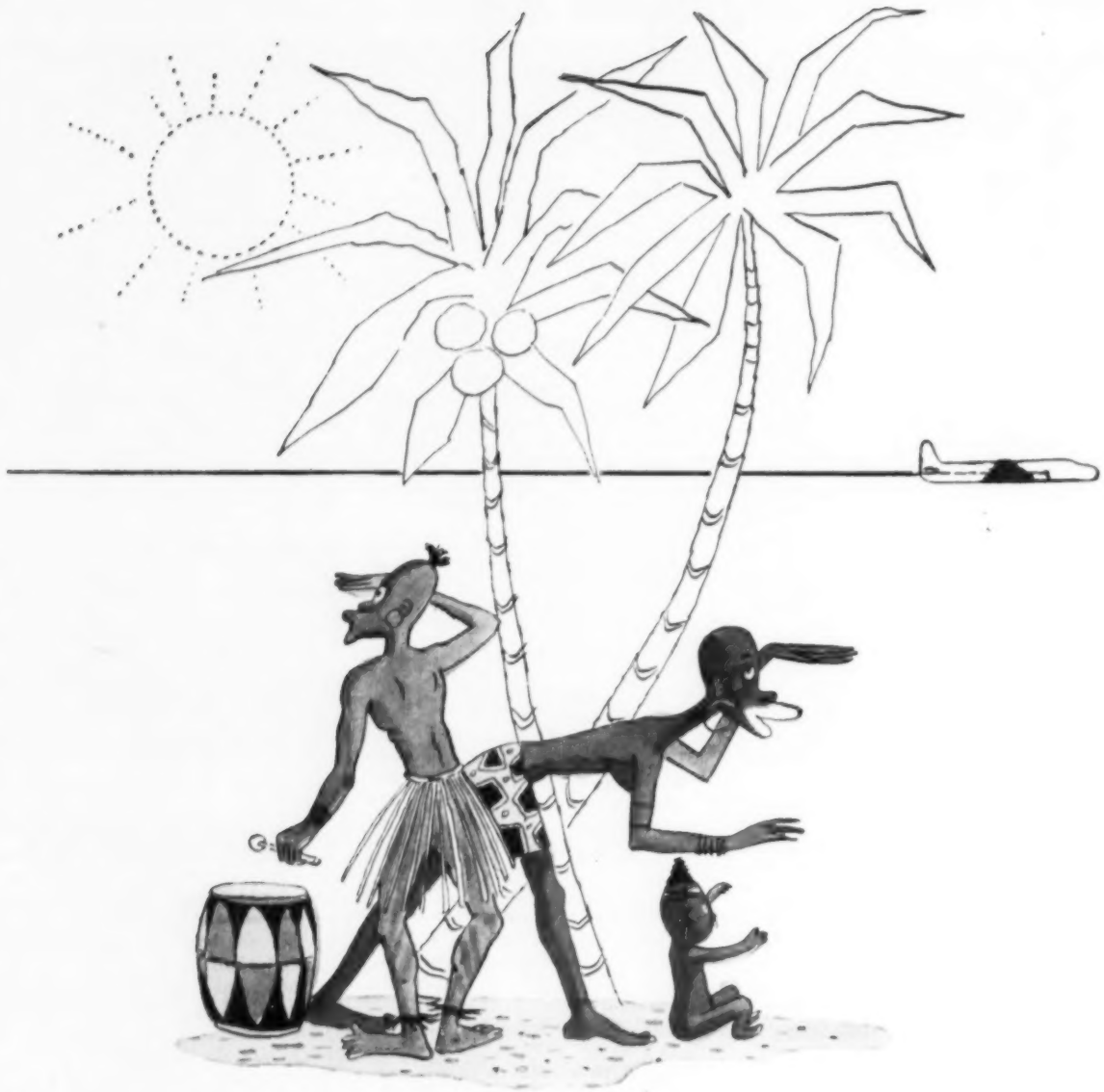
Specht was charged by the CAA with leaving his assigned altitude without permission on a flight between New York and St. Louis last Jan. 29 and, by climbing to a higher altitude, of passing through an altitude occupied by another airliner (ALPA comment, see p. 118).

The Captain said he had declared an emergency because of icing conditions at his assigned altitude and requested clearance to climb from 14,000 to 18,000 ft. (AW March 18, p. 30).

ALPA Asks CAB To Push Complaint

Washington—Air Line Pilots Assn. last week urged the Civil Aeronautics Board to take prompt action on its complaint charging airlines with publishing unrealistic schedules (AW May 6, p. 29).

In a brief filed with the Board, ALPA asked that CAB either proceed with the complaint or initiate a similar docket upon its own authority.



Around the equator 1,800,000 times!

Passengers on the scheduled air fleets of the world last year logged 45 billion miles—enough for one passenger to fly around the equator more than a million and three-quarter times! This figure represents a gain of 16% over total passenger miles flown in 1955. And this amazing record is expected to be broken again in 1957.

As more and more people fly more and more miles, new and better planes are being developed to serve them. To keep these planes flying, operators know they can rely on Esso Marketers for the finest in modern aviation fuels and lubricants—perfected through years of research—and for the finest in uniform, safe and efficient petroleum service along the airways of the world.

8 OUT OF 10 OF ALL THE WORLD'S INTERNATIONAL AIRLINES USE

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AVIATION PRODUCTS

UAL's Revenues Climb While Profits Drop

Chicago—United Air Lines last week reported a 5% increase in revenues for the first six months of 1957 but a sharp increase in operating expenses resulted in a decline in net earnings from $5.3 million for the same period of 1956 to $2.9 million.

W. A. Patterson, United president, said operating revenues amounted to $133 million, contrasted to $126 million for the same period of last year, but that earnings per revenue dollar were 1.1 cents in contrast to 3.6 cents a year ago.

Sales of surplus aircraft produced gains of approximately $1.5 million as against $737,000 for the same period last year.

Expenses climbed from $115 million during the first six months of 1956 to $129 million in 1957.

Operating income amounted to $3.8 million for the six months ended June 30, 1957, a drop from operating income of $10.9 million reported for the same period in 1956.

Slick Establishes Aircraft Sales Unit

Dallas—Slick Airways moved into the aircraft sales business by establishing a separate division to buy and sell airline transports.

If the new sales effort works out well, it will mean a further broadening of the cargo line's base of operations.

The carrier already supplements scheduled cargo service with special contract and charter activities and with engine overhaul work under contract with the Air Force.

In establishing the new division, Slick points out that, as the major airlines begin to convert to turbojet and turboprop equipment, some of their present piston-powered transports will be placed on sale.

Slick hopes to find a market for these aircraft among the smaller domestic carriers and among younger airlines of foreign nations.

"We feel there is a need for Slick's services in this aircraft market," Henry Huff, vice president of operations and maintenance, said in announcing the new activity.

"Through our own aircraft needs, we have become familiar with the equipment and, through our contacts on a world-wide basis, we are familiar with the potential customers."

In view of the facts that Slick is getting five new DC-6A freighters next year and that Douglas is discussing a

AIRLINE OBSERVER

► Northwest Airlines has entered into an agreement with Civil Air Transport, Formosa, whereby NWA planes will fly between Formosa and Hong Kong on a once a week basis, after Aug. 1. Northwest's present agreement to serve the British Crown Colony with three flights a week through an arrangement with Hong Kong Airways, Ltd. terminates July 31. Two years ago, President Eisenhower approved a Civil Aeronautics Board recommendation that Northwest be certificated to fly to Hong Kong, but the State Department has not yet obtained authority from the United Kingdom to inaugurate this service.

► Air Transport Assn. survey of air traffic control problems reports that reserved military airspace is increasing airline route mileage by 20 to 30%, and, in some cases, additional route mileage required to circumvent military areas is as high as 70%. Between New York and Washington, airline route mileage is increased by 28% because of zig-zag routings caused by military reserved airspace.

► Watch for an early order for jet transports by Iberia Airlines. Iberia President Dr. Tomas Delgado recently returned to Spain from the U.S. after long discussions with manufacturers on a jet equipment program. Boeing 707 appears to be the favored choice of the Spanish airline.

► Egypt has lifted its ban on British Overseas Airways Corp. operations into Egyptian territory. BOAC has not operated into Cairo since Oct. 28 when Israeli invaded Egypt.

► American Airlines will release 10 Convair 240s for sale in September. The airline will replace the Convairs with six DC-6s which it is converting from air coach to standard configuration. First of 11 DC-7s to be delivered early this fall will replace the DC-6s. American now operates 73 Convairs on its short and medium-haul routes.

► Lockheed is forecasting an increase in the Electra backlog to more than 200 units. Total orders are now 130. Although heavy development Electra expenses will hold earnings down this year, the company expects to reach a new high in commercial transport deliveries during 1957, with sales topping $200 million. Because the market for the 1649 Constellation did not materialize as anticipated, the company is forecasting a loss on this model. The 44 1649s to be produced during the year are not considered large enough volume to offset development costs involved in the redesigned wing and other changes.

► Airways Modernization Act has been reported out of the House Commerce Committee but not without dissension. Reps. John Moss (D.-Cal.) and John Dingell (D.-Mich.) charged that three years deferment for the establishment of a permanent Federal Aviation Agency is unnecessary and accused the Commerce Secretary of being reluctant to surrender control of the Civil Aeronautics Administration. They said Edward Curtis "labored for some 15 months to produce what may well be a literate blueprint of a house of Federal Aviation, but he recommends only the erection of a tool shed." The congressmen warned that the bill will not permit an airways system adequate to meet the jet age and added that it does nothing more than create a research and development agency without authority.

► New California law provides that runway approach zones must be approved by California Aeronautics Commission before a permit for a new airport is granted. Law prohibits the construction of buildings or the installation of any obstructions such as antenna towers and trees within the zone.

► Civil Aeronautics Board examiners have recommended the issuance of foreign air carrier permits to Compania Mexicana de Aviacion and Sociedad Aeronautica Medellin. The recommendations, if accepted by the Board, would give Mexicana authorization to operate from Mexico City to Chicago and San Antonio. Sociedad Aeronautica would be authorized to operate three route segments from Colombian territory; to New York and Montreal, to Miami and New York and to New Orleans.

An unusual opportunity to purchase a pressurized, airconditioned plane for corporate use!

American Airlines announces the sale of 8 Convair Aircraft (Model 240)

The Convair is an ideal plane for corporate needs. It is an outstanding dependable aircraft seating forty passengers in pressurized, airconditioned comfort. These planes have been fully maintained to airline standards. Priced at $375,000 each, one or two will be available September 1st—the remainder by October 1st. For information and specifications, write: Mr. B. L. Southwick, Manager Aircraft Sales, American Airlines, Inc., Tulsa O & S Depot, Tulsa, Oklahoma.

AMERICAN AIRLINES

America's Leading Airline

DC-7D freighter, the company recognized that it would be disposing of its older surplus transports over the next few years. Slick has seven DC-4s up for sale now, and some of its C-46 fleet will be available in the future.

Since the carrier will be selling and buying aircraft for its own use, Slick decided to expand the operation and turn this activity into a full time business. The division will be headed by Kenneth T. MacKenzie, who has worked for the airline since 1946. MacKenzie previously was with Curtiss-Wright, General Motors, Missouri Pacific Railroad and Wagner Electric.

In handling its used transport sales, Slick can either sell aircraft on a commission basis or buy them for resale. The carrier also could decide to overhaul the aircraft it buys in order to improve their market value.

Precedent for an overhaul operation was set this year when Slick's Burbank facility took a badly damaged Air Force C-118 and converted it to a DC-6 commercial transport. The DC-6 has been in service on the Slick system since May 1.

SHORTLINES

▶ **Panagra** has completed installation of airborne radar on all of its Douglas DC-6B and DC-7 tourist and first-class service. Panagra installed its first radar on a DC-6B in regular service between Miami and Buenos Aires in April, 1954.

▶ **Air France** flew its first Lockheed 1649 Constellation to be delivered from Burbank, Calif., to Paris in 17 hr., 11 min. The new aircraft took off from Burbank at 7:16 A. M. (PDT) on July 7 and landed at Orly Airport, Paris, at 8:27 A. M. Paris time, covering the 5,939 statute miles at an average speed of 339 mph.

▶ **Iberia Airline** of Spain has begun operating a third weekly first-class tourist-class combination service on its nonstop route between New York and Madrid. The flight, which leaves New York on Tuesdays, will continue through Oct. 1. Westbound, Iberia offers a third flight on Mondays scheduled to continue through September 30.

▶ **Airline Clearing House** reports that airline business transactions during May were up 13.67% over May of last year. Total interline business transacted was $65,962,601.08 as compared with $58,028,325.09 in May 1956.

▶ **Aerolinas Argentinas** has been released from Argentine Air Ministry control and has been granted the status of a corporation, totally state owned.

COCKPIT VIEWPOINT

By Capt. R. C. Robson

Zero-Zero Landings — II

The all-weather experimental lighting display at the Andrews Air Force Base was described last week. Since the installation was temporary, the various fixtures were simply placed on top of the runway surface. Because of these steel and concrete obstructions actual touchdowns were avoided. Generally we maintained a safe altitude of 10 to 20 feet above the pavement although all pilots agreed that if the lights had been flush mounted normal safe landings could easily have been made.

Good Testing Conditions

Meteorological reports indicated zero-zero for all approaches. Ceilometer and transmissometer observations taken on each approach varied from a 50 foot ceiling and 400 feet visibility to as high as 1,000 feet runway range visibility. By any standards this is "low weather" and can be deemed a fair climate for testing. (It also indicates some serious discrepancies in our weather reporting methods but that is another story.)

One of the first things evident was that the 90 foot gauge (a row of lights 45 feet on either side of the center of the runway) was inadequate. It required noticeably more "interpretation"—and therefore hesitancy—before a pilot would commit himself to a landing. In general it gave the same appearance as a narrow runway with normal edge lights. The 60 foot gauge was by far the best of the lot.

Longitudnal spacing of these lights every 200 feet seemed adequate when visibilities were better than 700 feet. At the lower limits the 200 foot spacing was inclined to leave gaps and destroy the "line of light" effect. Also, this was a homogeneous fog condition, not rain or blowing snow, which we have not flown yet and which might obliterate one or more fixtures. At this point it would appear that 100 foot spacing on the 60 foot gauge is the best answer.

The Sylvania edge floodlighting provided a surprisingly good amount of light on the runway surface with little glare. The outline of the runway was closely delineated. My own opinion (one shared by several other pilots) is that the floods did not provide enough depth perception—not enough indication of ground plane. There was no focal point which I could "grab on to" for landing. Sylvania is now working on an improved light plus centerline reflectors which may help this problem.

May Need 3,000 Ft.

Narrow gauge lights at Andrews extended for about 2,200 feet down the runway. This seemed adequate for the conditions we had. But remember we have not flown it in rain or snow or with heavier, faster aircraft which may need more leeway. For our major terminals it may be that a full 3,000 feet will be needed to cover all weather conditions. Smaller fields and smaller aircraft with higher limits may find 2,000 feet suitable.

There is also the very real problem of what to do with the airplane after it is on the ground. From personal experience I can testify that it is a helpless feeling to land and then have to be towed to the terminal. There must be some visual guidance which will allow the pilot to find the high speed turn offs and steer safely off the runway. At this point we are experimenting with a single row of centerline lights, commencing where the narrow gauge leaves off, and wondering if these can curve into the turn off areas with sufficient guidance.

Many runways will be extended a thousand feet or so to accommodate our coming jets. Serious considerations should be given to installing flush lighting in these, and new, runways. I guarantee that narrow gauge lighting will enhance our on schedule operations. Next I will discuss crew coordination and visual training aids.

Large or Small, General Electric Gas Turbine Engines Deliver More Power Per Pound, Give America's Aircraft Greater Mission Capability

The low specific weight of the General Electric J79 and T58 gas turbine engines, when translated into smaller, lighter airframes, helps increase aircraft range and payload. Benefits like these stem from the advanced, high-power, light-weight design common to both the T58 and the J79. Each delivers more power per pound than any other comparable engine in its class.

The J79 and T58 join more than 31,000 General Electric J47 and J73 engines now flying 5,500,000 miles daily from bases around the world. Both have evolved from a family of aircraft gas turbine engines dating back to the nation's first jet engine, the G-E I-A (1942). Teamed with the products of ever advancing airframe technology these two General Electric engines are now making possible aircraft of unsurpassed operational effectiveness. General Electric Co., Schenectady 5, N. Y. 210-103

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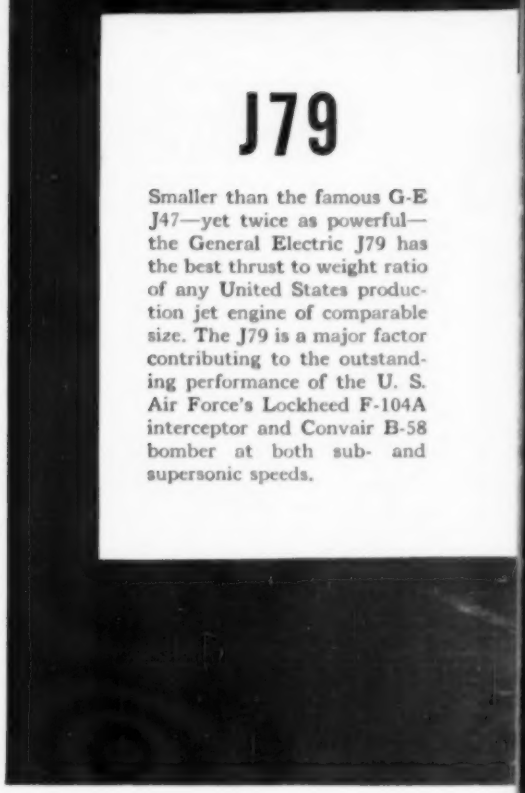
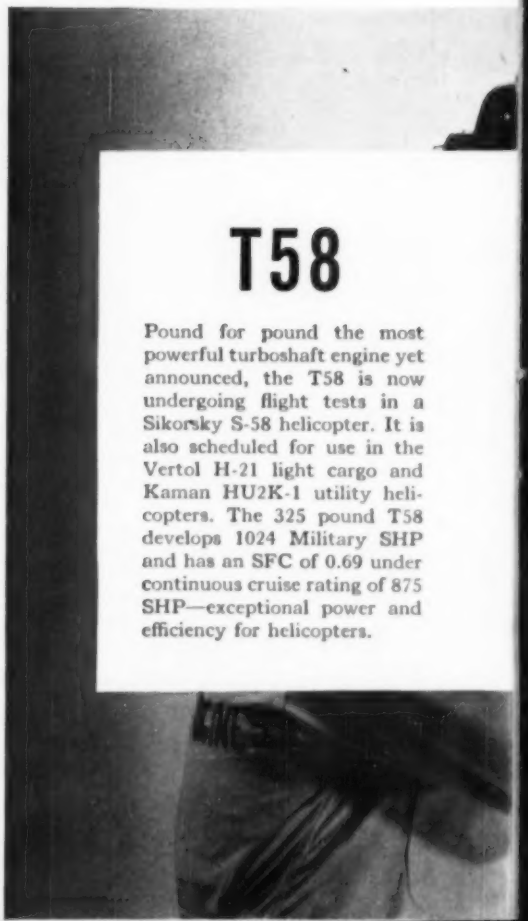


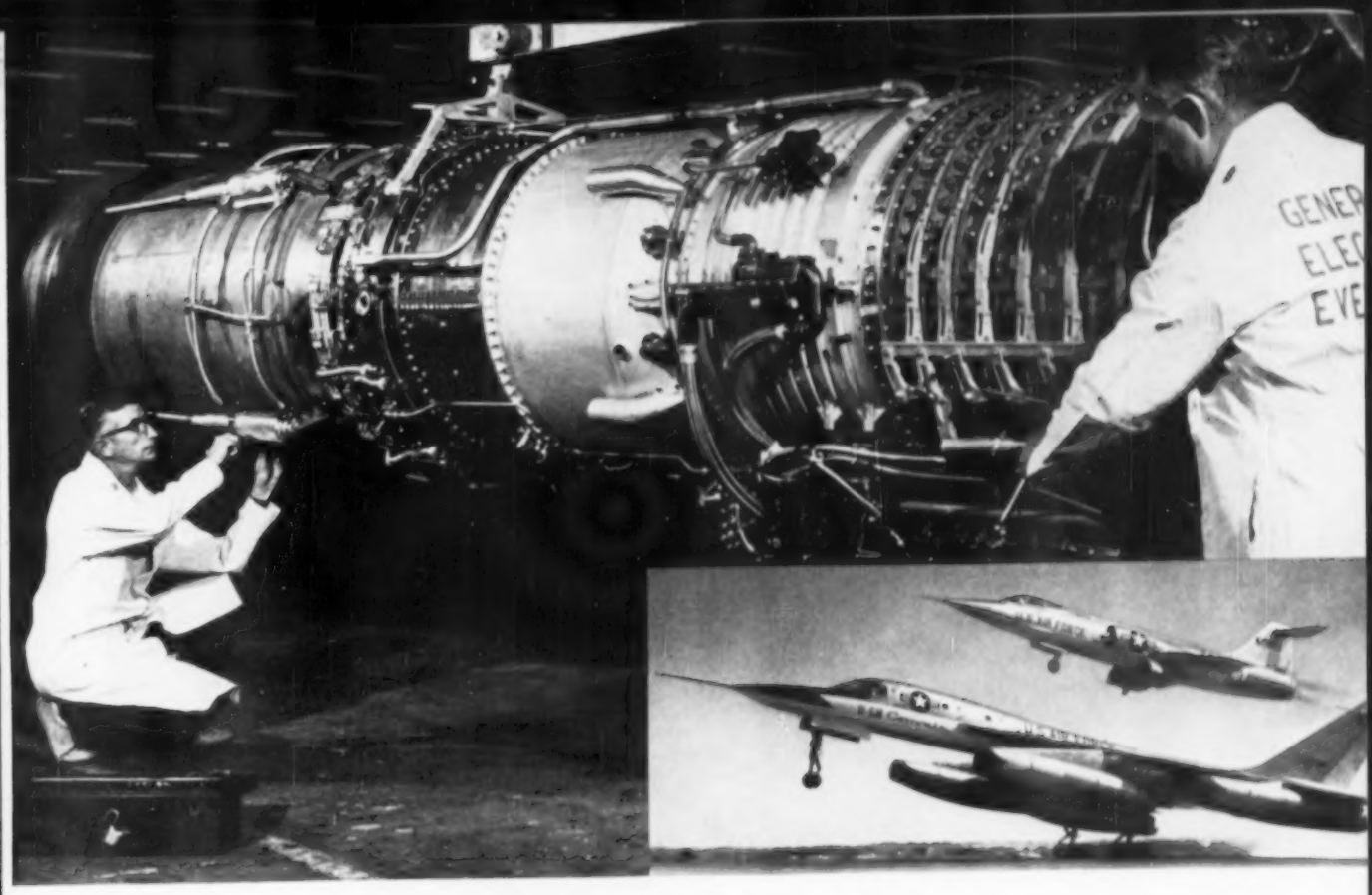
J79

Smaller than the famous G-E J47—yet twice as powerful—the General Electric J79 has the best thrust to weight ratio of any United States production jet engine of comparable size. The J79 is a major factor contributing to the outstanding performance of the U. S. Air Force's Lockheed F-104A interceptor and Convair B-58 bomber at both sub- and supersonic speeds.



T58

Pound for pound the most powerful turboshaft engine yet announced, the T58 is now undergoing flight tests in a Sikorsky S-58 helicopter. It is also scheduled for use in the Vertol H-21 light cargo and Kaman HU2K-1 utility helicopters. The 325 pound T58 develops 1024 Military SHP and has an SFC of 0.69 under continuous cruise rating of 875 SHP—exceptional power and efficiency for helicopters.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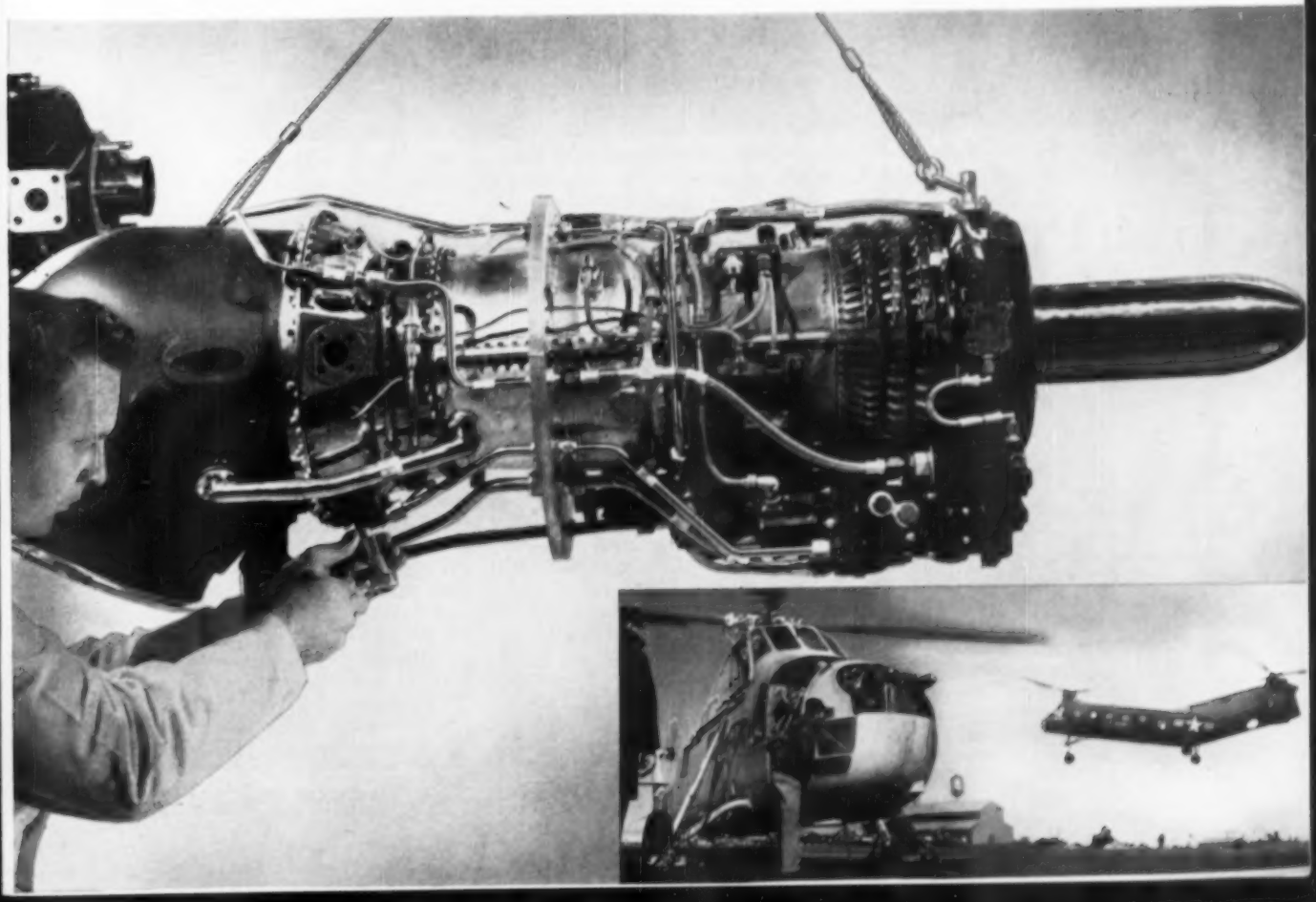


PLANVIEW photograph of Canadair CP-107 Argus in flight indicates similarity of wings and tail to Bristol Britannia, from which it was derived. Flush antennas on top of the fuselage at wing are among the 40 mounted on the airplane. Tail extension is for MAD gear.

Test Program for CL-28 Moves Ahead

Montreal—Second Canadair CL-28 long range reconnaissance airplane for the Royal Canadian Air Force has made its first flight and the third airplane has rolled out the door, making for a production schedule of one a month.

The first airplane, which flew last spring, has completed more than 42 hr. of the 67 hr. of its Phase I flight test program. Phase I program will include basic tests of all components—electrical system, fuel flow system, etc.—and will pave the way for delivery of the third aircraft to the RCAF early this fall after the usual routine flight test to establish its airworthiness.

Although the first airplane presents a relatively clean look in these flight photographs, it is serving as a guinea pig for all the changes requested by the military and is beginning to acquire the same sort of "Christmas tree" character that the P2V, which it is designed to supplement with the RCAF, developed after service use by the U.S. Navy.

First two airplanes will be retained by Canadair for further testing.

Transport Version

RCAF also has ordered a transport version of the airplane, which will be powered by Bristol Orion turboprop engines instead of the Curtiss-Wright R3350 Turbocompound engines of the CL-28. Transport is designated CL-44, pending a choice of a name and number by the RCAF (AW April 22, p. 28). RCAF designates the reconnaissance airplane the CP-107 Argus.

Canadair also is offering either the military or civil version for sale, but reports no firm orders for either. Campaign is being conducted in unison with Bristol Aeroplane Co., from whose Britannia design the CL-28 was derived.

Describing the engineering of the airplane at a recent meeting of the Engineering Institute of Canada at Banff, W. K. Ebel, vice president, engineering, and Everett B. Schaefer, assistant chief engineer, said that the fuselage redesign amounted to about 95% of that required for an original design. Wings and tail are largely the same, but installation of the piston engine necessitated 100% new design forward of the firewall.

Much of the redesign was needed to convert materials, parts and equipment to American standards. One case was the hydraulics, which in the Britannia are designed around a 4,000 psi. pres-

sure supply. As such, it is entirely satisfactory, the Canadair engineers said.

Practically all aircraft operated by the RCAF have 3,000 psi. systems, and stock supplies of pumps, pressure reducers, accumulators, fittings and lines are available in supply depots. For uniformity, and based on experience, the hydraulic system in the CL-28 was redesigned to a 3,000 psi. base, the capacity adapted to a somewhat greater demand because of the addition of hydraulically operated equipment, at bomb bay doors.

Sonobuoy Ejection

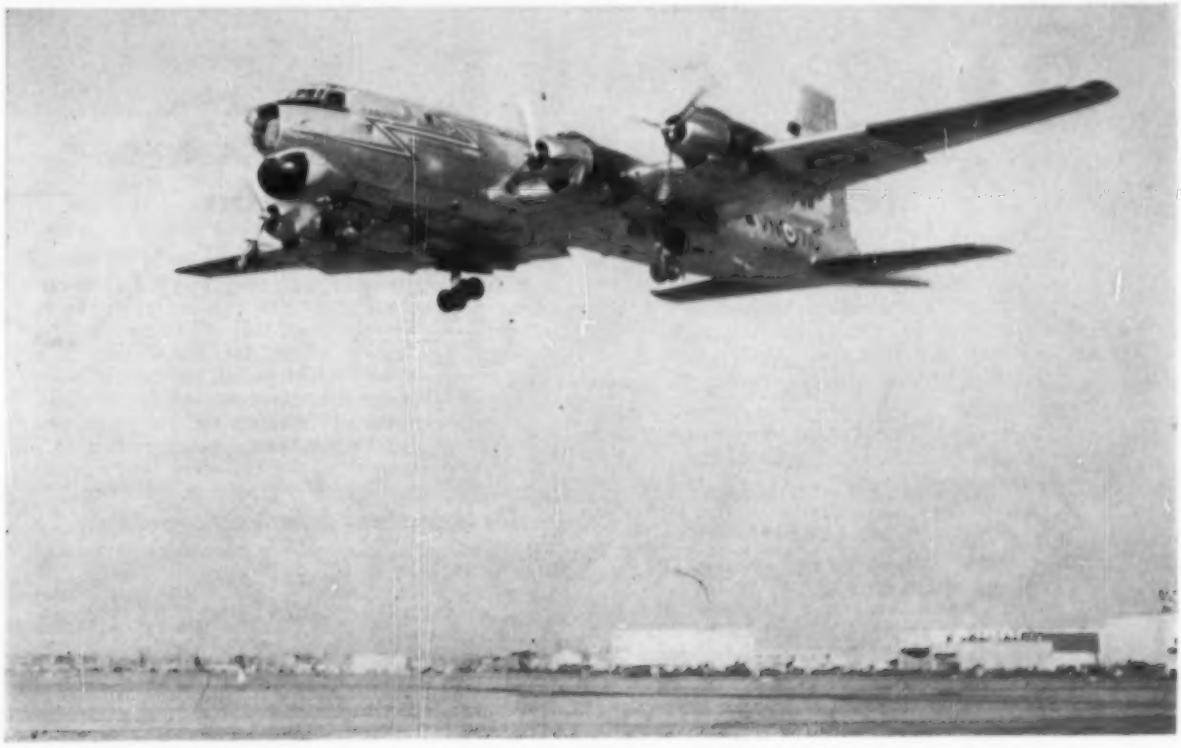
Furthermore, a pneumatic power system, not available in the Britannia, was designed and developed and utilized for sonobuoy ejection. Canadair said this is the first time such stores have been power ejected.

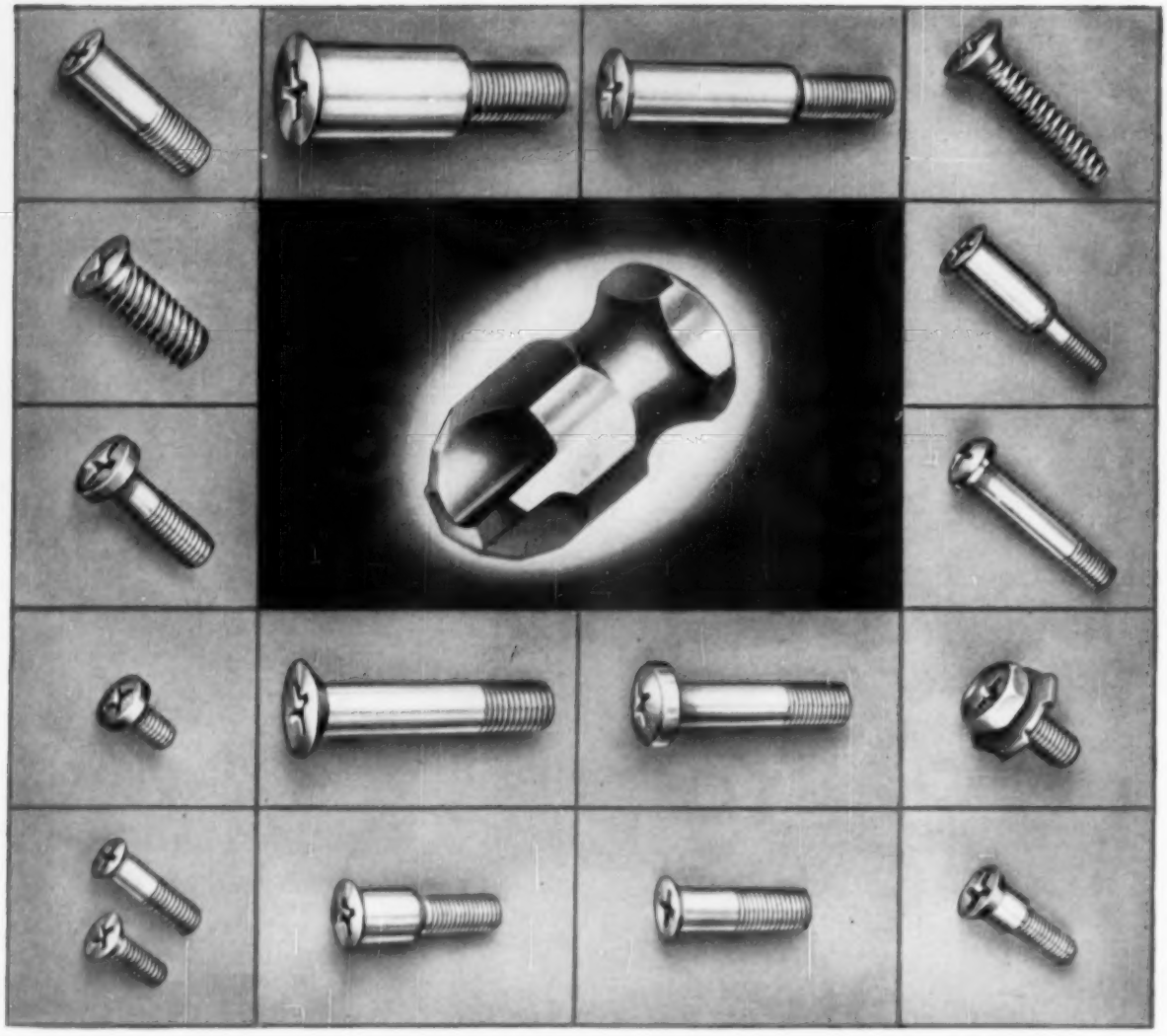
Approximately 18,000 engineering drawings were required for 70,000 detail aircraft parts. Of these, 8,000 were Bristol drawings with Americanized processing. The other 10,000 represented the bulk of the engineering design effort. Since it began in April, 1954, the engineering effort expended was equivalent to 1,000 man-years, and peak manpower totals were 530.

Electrical power supply was a major problem since the airplane carries about 4,000 lb. of avionic and communication equipment requiring 40 antennas.

Among them is a dielectric insert in

ARGUS in profile displays chin radome and redesigned nose. Radome has recess (below) to partly accommodate nose gear.





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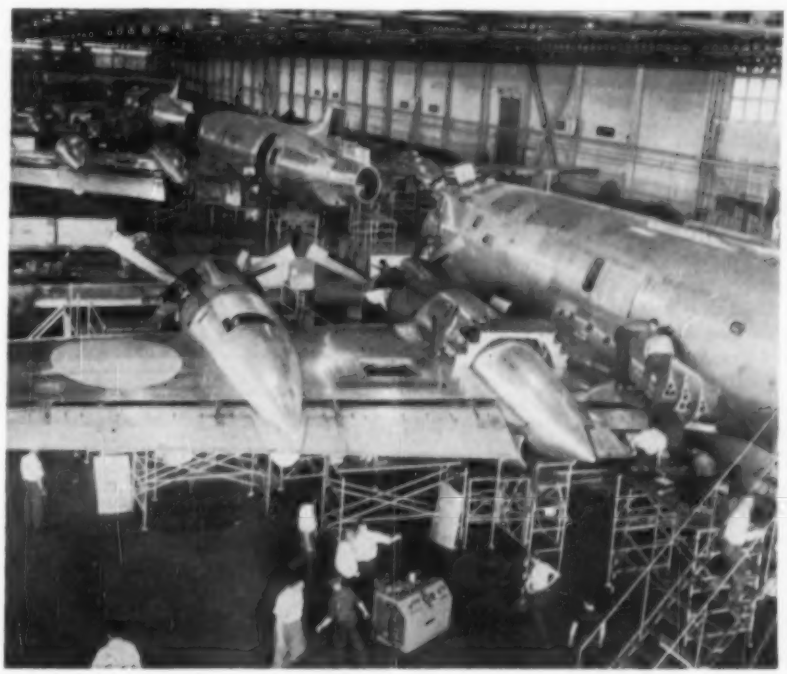
THREE FUSELAGES are on assembly line at Canadair. Fuselage moves backward with vertical fin, because of its height, installed last in section of plant where bay is high enough to accommodate it. Part of factory wall above door had to be cut out to permit Argus to roll out.

the vertical fin in which a Fibreglas section near the top is utilized as a full load carrying structure. C. A. Bloom of Canadair, in describing the Argus structural test program at the annual general meeting of the Canadian Aeronautical Institute, said the static test program of which the insert is a part will continue through next month.

First phase of testing of the insert consisted of torsional and bending stiffness tests, loads being applied to the fin top either above or below the insert by cables, pulleys and dead weights. "The Fibreglas panels," Bloom said, "proved a little more flexible than the aluminum alloy construction."

The large nose radome for search radar gear was a similar situation. It was tested by application of rubber water bags to the Fibreglas honeycomb surface with pressure varied to produce correct distribution.



Radome Test

Little permanent set occurred under ultimate conditions, and in another test, 129% of ultimate design load was reached before the radome tore away at the connections along one side and the front.

Major structural change in the fuselage was the inclusion of the bomb bay. In the Argus a longeron above the wing, a heavy bomb bay longeron and spar box frames perform the same functions as longerons above and below the wing in the Britannia perform in transferring shears from the wing surfaces directly fore and aft of the wing box, and box frames bolted to the wing spar perform in transmitting shears to the fuselage shell.

Because of reduced distance between horizontal members in the Argus, the shears tend to peak up and heavier skin gages around the wing box were needed.

Nose section was revised completely in the Argus and fuselage cutouts were altered for the military requirements. As a result of the revisions, and because the Argus is unpressurized and the critical design shears and bending moments differ appreciably, most of the skin stringer panels were redesigned.

Static tests generally proved the

Sperry B-58 Control

Convair B-58 Hustler's primary navigation and guidance systems will be produced by Sperry Gyroscope Co. under follow-on contract. The systems direct B-58's flight path through signals to its autopilot, also control release of plane's "throw-away" pod at a precise point in space.

According to joint USAF and Convair announcement, the equipment, presently undergoing test-bed flights in C-131, C-97 and B-36 aircraft, is ten times as accurate, requires 37% less space and weighs 20% less than present operational systems.

soundness of the design, although changes had to be made in a few cases. In a simulated side gust on the vertical tail, the limit load was carried successfully without permanent set. However, the inner flange of the rear bulkhead rolled badly and will need stiffening.

Metal bonding, a process unfamiliar to Canadair, was necessitated by the Britannia design. Eight skin stringer panels, representative of various sections of the aircraft, were tested at various gust intensities—two bonded, six riveted. There was little to chose between bonded and riveted sections as far as fatigue life is concerned, Bloom said.

Fork Fittings

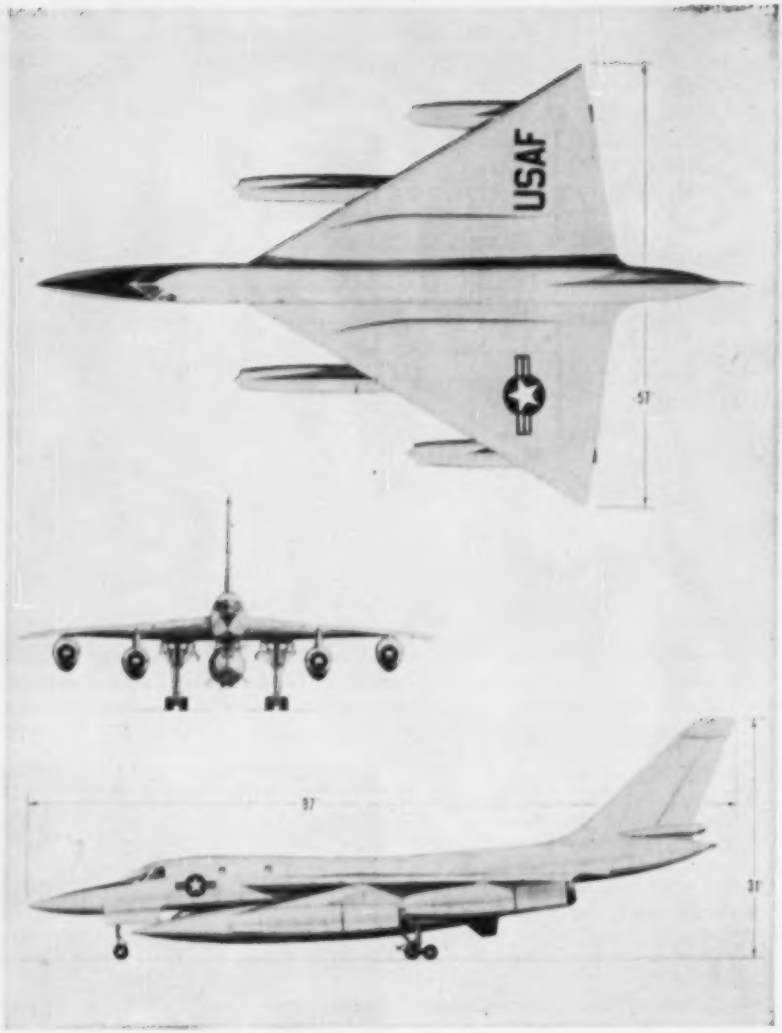
Fork fittings emerged as the weak links, failing at approximately half a million cycles. Though adequate for the Argus, a development program is being carried out.

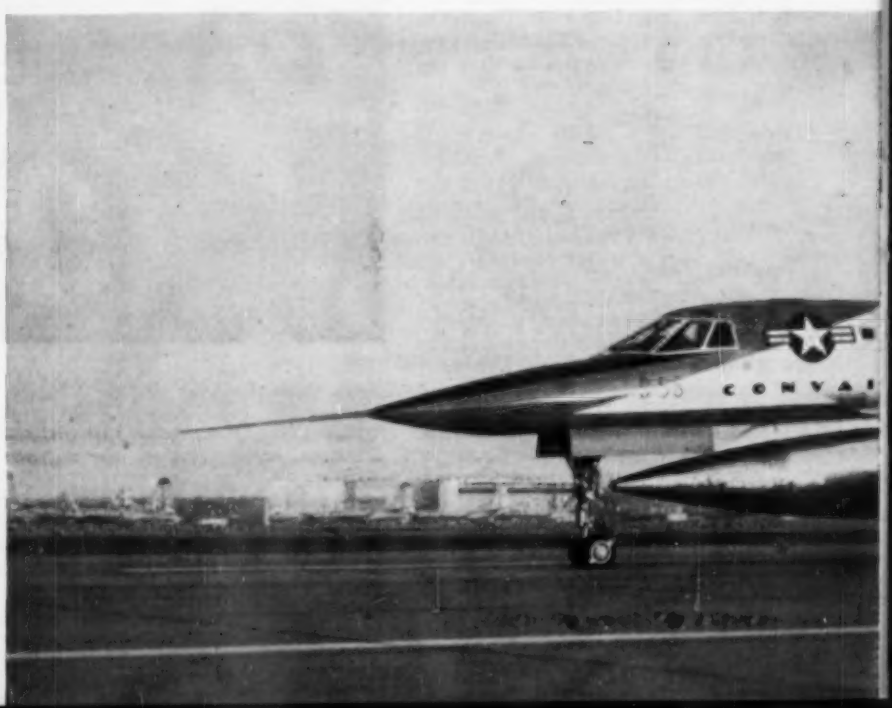
Further tests are scheduled for a fuselage and tail specimen and in the fifth phase of the program it will be tested to destruction. If, as expected, the fuselage breaks aft of the wing box, ditching tests will be simulated by means of pressure bags, this constituting the sixth and final phase of the program.

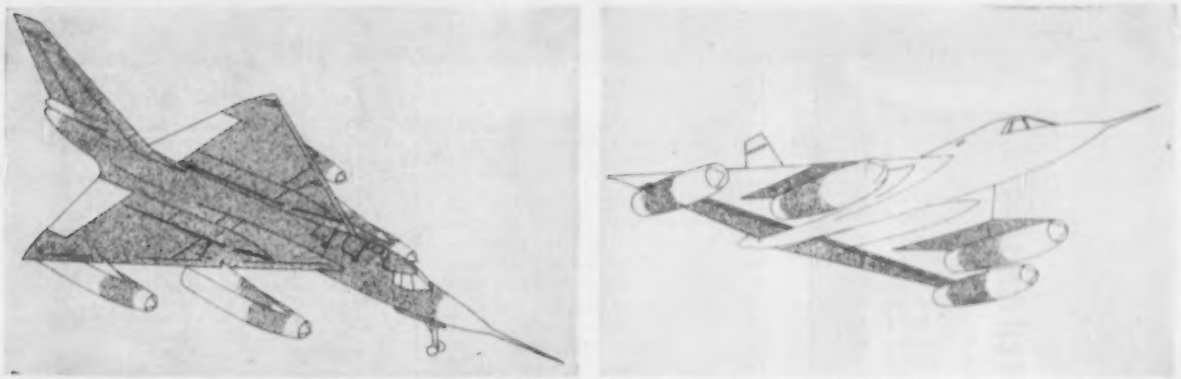
RCAF requirements (AW Feb. 11, p. 26) demand operation of the aircraft under all climatic conditions to lows of −65F. Since the piston engines provide no source of warm bleed air as do the Britannia turbine engines, four internal combustion heaters with a total capacity of 2,100,000 Btu. were installed. They draw fuel from the aircraft fuel supply.

RCAF specialist groups will join in the testing program. It will run for about two years and will be carried out on the first five to seven aircraft.

A major phase of the ground test program has been installation of the electrical equipment on a simulated fuselage to determine whether there was any interference from any of the electrical gear.







SHADED AREAS in the sketches indicate the location of sandwich type structural panels used for the B-58 skin. Sandwich (left) is formed by bonding aluminum or steel outer panels to the honeycomb filler. That in the drawing at right is formed by brazing stainless steel sheets to a metal honeycomb core. The brazed panels are exposed to engine and exhaust heat as well as aerodynamic heating.

B-58 Makes Extensive Use of Honeycomb

Convair B-58 Hustler, dimensions of which are shown in three-view (left), carries various types of detachable pods. The one shown (right) does not emphasize size, which is 35% longer than an F-51. The various pods available for use on the Hustler are each tailored for a specific mission. They usually contain a considerable amount of fuel as well as a weapon. Several configurations of stabilizing and lifting surfaces have been tried on the pods indicating that the problem of carrying and dropping such devices is not easily solved. Lower photo shows one combat configuration landing with drag chute extended. The USAF bomber was unveiled at Convair's Ft. Worth, Tex., plant (AW July 15, p. 28).

SPECIFICATIONS

208/120 Volts, 0.75 Power Factor, 3 Phase, 400 CPS

Type No.	Rating KVA	Rated Cooling Air Pressure in "H_2O"	Rated Cooling Air lb./min.	Diam. in.	Speed RPM	Approx. Weight lbs.	Flange and Drive Spline
*28E16-1	20	4	11	8.25	5700-6300	60	AND 10266 XVI-A
*28B23-1	20	4	11	8.25	4800-7200	65	AND 10262 XII-A
*28E17-1	30	8	14	8.25	5700-6300	69	AND 10266 XVI-A
*28E14-1	40	5	14.5	9.25	5700-6300	83	AND 10266 XVI-A
*28E15-1	60	6	16	9.25	5700-6300	103	AND 10266 XVI-A
28E19-1	10	4	7	6.5	7600-8400	30	AND 10262 XII-A
28E19-3	10	4	7	6.5	7600-8400	31	New 9" Flange
28E20-1	20	6	8.5	6.5	7600-8400	45	AND 10262 XII-A
28E20-3	20	6	8.5	6.5	7600-8400	46	New 9" Flange
28E21-1	30	10	12.4	6.5	7600-8400	60	AND 10262 XII-A
28E21-3	30	10	12.4	6.5	7600-8400	61	New 9" Flange
**28E10-1	9	6	8.6	6.5	7600-8400	39	AND 10262 XII-A

*These generators include integral fan permitting full load continuously up to 80°C. at sea level with no additional cooling.

**This generator incorporates a DC output of 30 volts, 50 amps capacity in addition to the AC output.

All generators have been designed to MIL-G-6099 and MS-33542, which specifies cooling air of 120°C. at sea level, 40°C. at 50,000 ft., and −12°C. at 65,000 ft., and will deliver full-rated load under these conditions.

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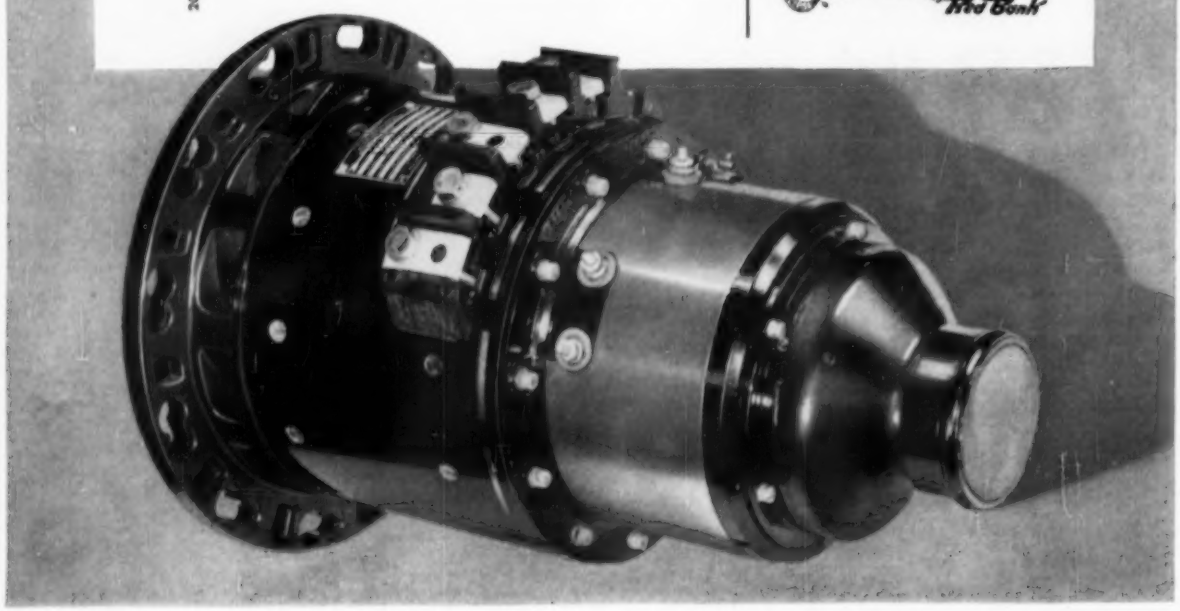

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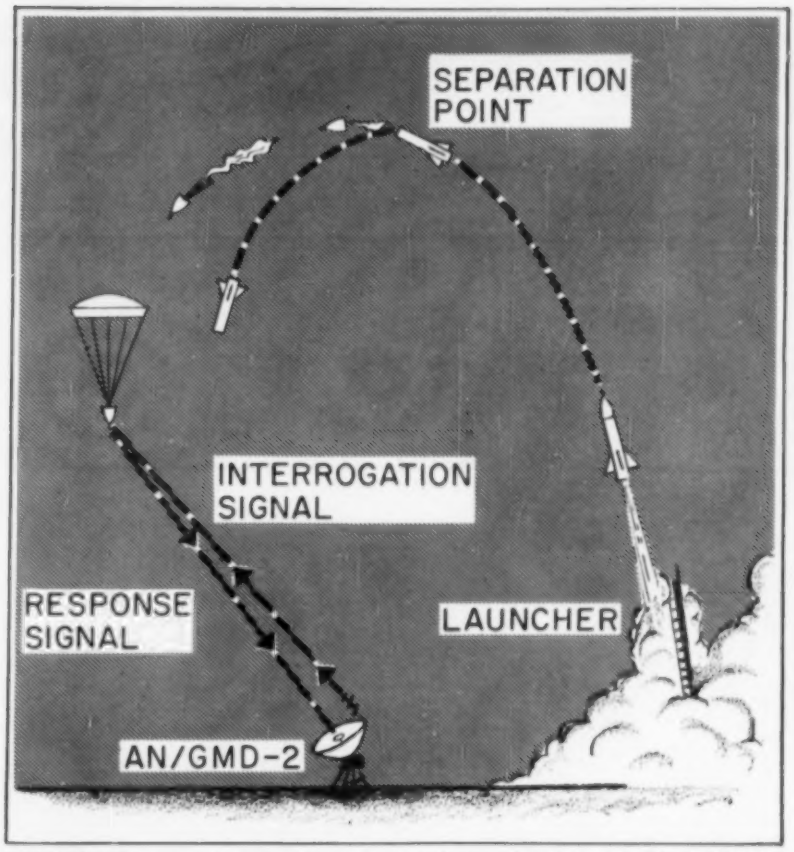


ROCKETSONDE system is proposed means of getting weather data at 70,000-150,000 ft.

Low-Cost Rocket Vehicle Urged For High-Altitude Weather Data

Reliable meteorological data at altitudes between 70,000 and 150,000 ft., above the ceiling of routine balloonsonde observations, can be obtained by U. S. Weather Bureau using low-cost rocketsonde system, feasibility study by Sanford Research Institute, Menlo Park, Calif., indicates.

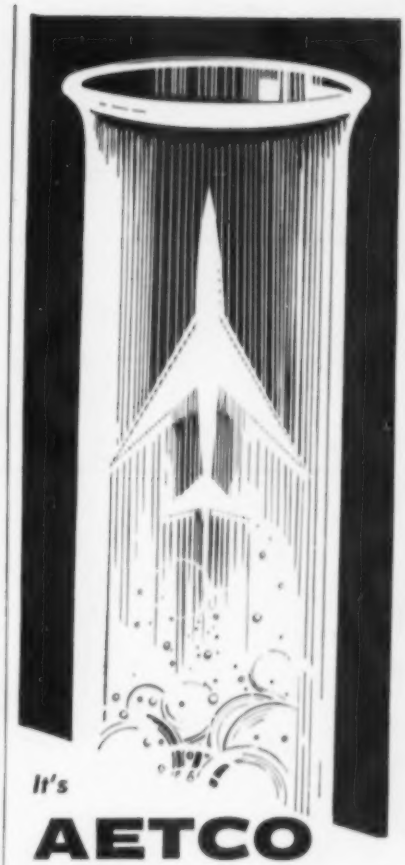
Study was made for Federal Civil Defense Administration, which needs such information on frequent and accurate basis for predicting atomic fallout patterns and contaminated cloud travel.

Study showed desired characteristics of rocketsonde should include:

- **System which can** be operated in entirety by Weather Bureau personnel without extensive training program.
- **High order reliability** in data acquisition and operation of system as a whole.
- **Low overall developmental** costs utilizing as many presently known techniques as possible.
- **Propulsion units** inexpensive enough that unusual budgetary provisions need not be made to insure adequate supply for high consumption rates.

SRI recommendations for the system are:

- **A single-stage** solid propellant rocket to carry a parachutesonde to 150,000 ft. where it would be released.
- **Tracking and telemetering** meteorological data by AN/GMD-2 rawinsonde system being developed by Army Signal Corps, with modification of ground equipment for faster tracking and ranging, plus development of a single, dual-frequency band rocket antenna.
- **Development of a parachute,** probably a guide-surface type, which would open consistently at 150,000 ft. The parachute also would reliably follow wind profile in descent.
- **Development of a thermistor** with a properly selected reflective coating which could function adequately as a temperature sensor at the altitudes of interest. Since present sensing elements are inadequate, pressure and humidity readings would not be taken by the system to begin with, but development of a hypsometer for pressure sensing



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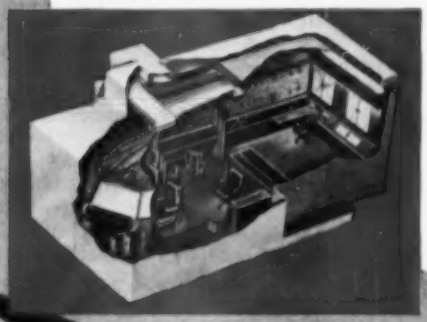

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for eventual inclusion should be worth the effort.

• **Development of a rocket** vehicle capable of mass production for approximately $100.

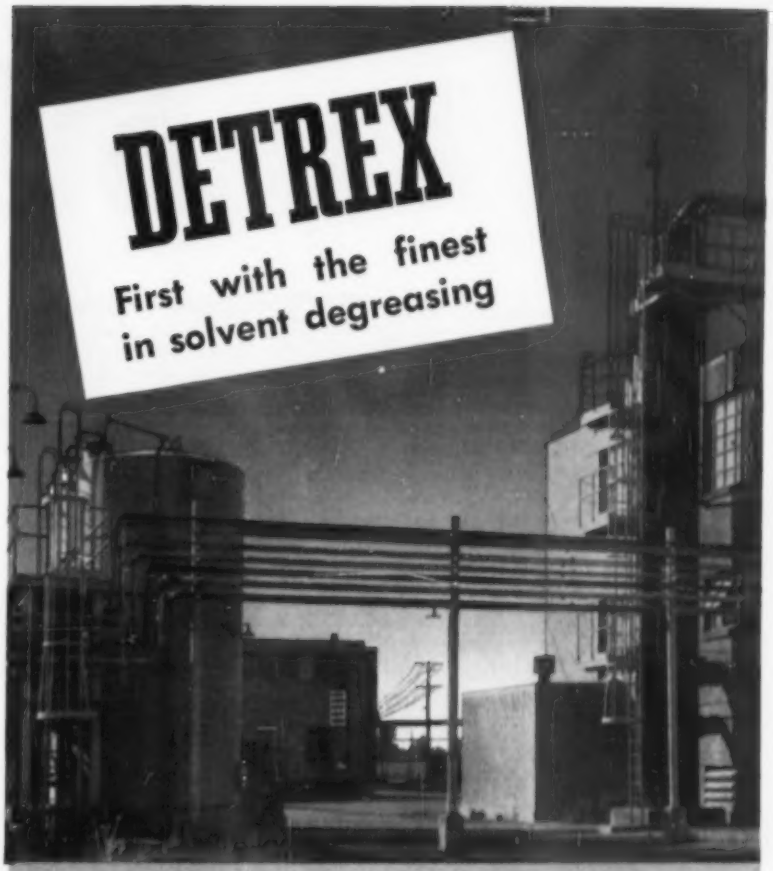
General specifications of the rocket envisioned by SRI indicate it would be about 4 to 6 in. in diameter, 6 to 8 ft. long and have an impulse of 8,000 to 10,000 lb.-sec.

It would carry a payload weighing approximately 12 lb., including nose cone and ejection mechanism, to 160,000 ft. with maximum accelerations held to 25 to 30G.

While SRI pointed out that eventually the most desirable system would include a rocket motor case which could be fragmented, burned or pulverized to eliminate public hazard, the study recommended a present alternative of a network of remote stations which, while in areas where danger is minimized, could provide adequate coverage of continental U. S. Network stations all

CF-105 Main Landing Gear

Main landing gear for Avro's delta wing supersonic interceptor, the CF-105, features a single-wheel, tandem axle to permit stowage in a very thin wing box. The relatively long undercarriage is required by the delta wing configuration of the aircraft. In order to stow it within the space available, the gear has to be shortened 8½ in. during retraction by a special linkage. Design of the wing structure made it necessary to provide a skew axis for the pivot shaft which in turn necessitated twisting of the landing gear strut during retraction. The undercarriage is made of ultra high tensile steel with a strength level of 260,000 psi.



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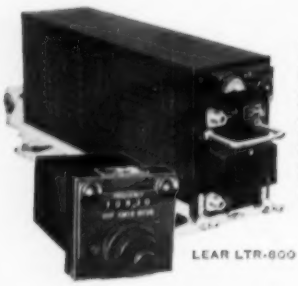

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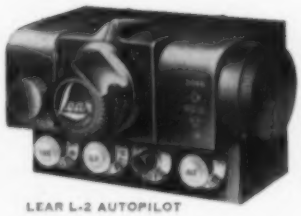

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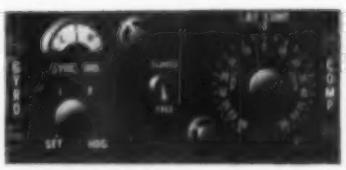
FINEST GYRO-STABILIZED latitude-compensating compass available. LEAR LC-1 is reliable and accurate even in high latitudes and magnetic storms. Navy's choice (designated Type MA-1) over all similar directional systems.



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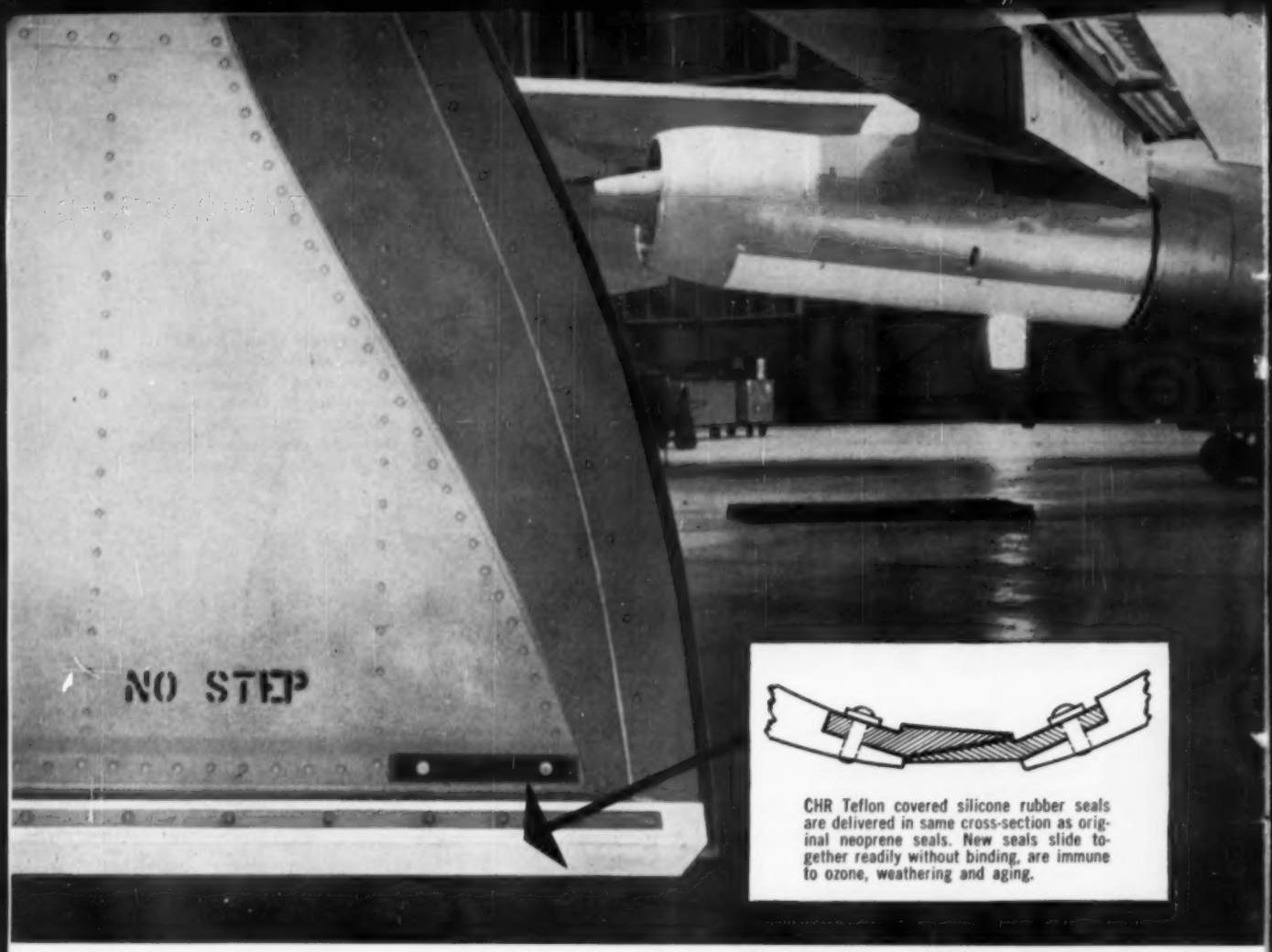


CHR Teflon covered silicone rubber seals are delivered in same cross-section as original neoprene seals. New seals slide together readily without binding, are immune to ozone, weathering and aging.

CHR adapts new seal development to B-47 bomb bay doors.

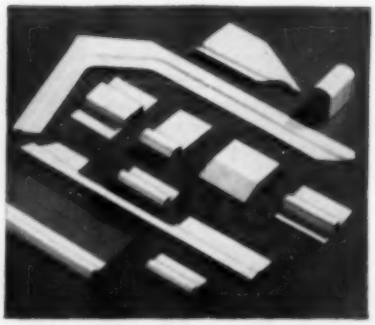
Teflon covered silicone rubber seals developed by CHR are replacing original neoprene seals. Here's why . . .

Extreme low temperature operating conditions played havoc with the neoprene rubber seals originally designed for B-47 bomb bay doors. Hardened by aging and cold, many of the seals split and ripped off when doors were opened and shut in flight.

CHR Teflon covered silicone rubber seals shown above solved the problem. Silicone rubber is immune to ozone, weathering and aging. The almost frictionless Teflon surface permits seals to mate readily without cracking or binding. The seals have -100°F to 500°F flexibility. They seal out and also shed water, ice and dirt. The white color provides reflective protection against radiation from nuclear weapons.

CHR Teflon covered seals are also being used on other planes where low friction, sliding action, abrasion resistance and resistance to fuels and synthetic lubricants is required.

Our experience in helping engineers with all types of airframe and engine seals utilizing all forms of silicone rubber reinforced with fabrics, Teflon and metals can be put to work for you. We solicit your inquiries for specific applications. Call or write. CHR field representatives are available for direct contact.



CHR Teflon covered seals are now being produced in many shapes and forms using all types of silicone rubber . . . solid, sponge and foam (COHRfoam).

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are presently existing and operating USWB facilities.

SRI estimates total cost of development, which could be spread over a two- or three-year period and includes the 56 rocket qualification flights required by military agencies, at approximately $620,000.

Estimated cost of expendable units, including instrumentation, parachute and rocket, was set at $155 each if production rate approximated $100,000 per year.

Laboratory to Study Astronautics Fields

Azusa, Calif.—Aerojet-General Corp. has established astronautics research laboratory to conduct studies in principal areas of propulsion, astrophysical chemistry, and materials.

Laboratory has three sections:

- **Propulsion section** will investigate ultra-high energy chemicals, and ion, gaseous free radical, and nuclear plasma propulsion systems.
- **Astrophysical section** will conduct research in magnetohydrodynamics, physics and chemistry of extraterrestrial matter, interactions of space vehicles with environment, and temperature reactions.
- **Materials section** will engage in studies to develop high and low temperature materials for extraterrestrial propulsion systems and vehicles.

Wing Formed to Train IRBM-ICBM Crews

Formation of the 704th Strategic Missile Wing at Cooke AFB, Lompoc, Calif., to organize and plan ballistic missile crew training has been announced by Maj. Gen. B. A. Schriever, chief of the Air Force Ballistic Missile Division of ARDC.

The 704th has assumed command of the 392nd Air Base Group which is the housekeeping unit at the base. Col. William S. Rader will command the 704th.

CAA Convair 440 Equipped for Tests

AiResearch Aviation Service Co., Los Angeles, is installing a GTP70-10 gas turbine in a CAA Convair 440 as auxiliary electrical power unit. CAA plans to flight check radio navigational and communications facilities with the airplane throughout the U.S. at altitudes between 10,000 and 20,000 ft.

AiResearch also is installing a two-screen radar set in the plane, one viewplate in pilot's center panel, other at electronics operation station in cabin.

Gassing Up At 530 M.P.H.

This Flying Pipe refueling system, developed by Thieblot Aircraft Company, vastly extends the range of jet planes, especially fighters.

This hitherto-secret device is a packaged unit containing a "flying pipe" to enable fighters to transfer fuel at altitudes above 30,000 feet and at speeds over 530 miles per hour. It should soon make fighter-to-fighter refueling commonplace. Formerly only slower planes could be used as tankers.

The Flying Pipe is one of the outstanding new Thieblot projects, developed over the past two years under contract to the Aircraft Laboratory of Wright Air Development Center.

The Flying Pipe is a prime example of the special abilities of Thieblot Aircraft Company in designing and producing aircraft components and ordnance.

Other Thieblot contributions include a ballistics-data aircraft nose for cross-wind firing; purge mat systems for jet trainers; a boundary layer control system; a nose-wheel steering mechanism; an escape reel for ditched aircraft; and other equipment of advanced technology.

For both government and industry Thieblot is making tomorrow's aircraft technology available today.

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*10 billion to 1 ratio
gear reduction train . . .
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No larger than your thumb, this gear train is ready . . . and working. Its use is classified, but what would you use it for? Here is an off-the-cuff computation you might consider: at 5,000 RPM input, output is one revolution/3.8 years. And, as an added advantage, its efficiency is amazingly high.
Elgin's constant search for new ideas and concepts has built a production and research organization extending from Elgin, Illinois to Lincoln, Nebraska to Conoga Park, California. The development of a 10 billion to one ratio gear train is a single example of Elgin's ability to create tomorrow's products today. It can do the same for you in the field of time-metering instruments, fusing, safety and arming devices, and small precision gearing, gear trains and differentials.
Elgin's rapidly expanding technical staff now offers a broad scope of opportunities for qualified engineers and technicians.
ACTUAL SIZE
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First Sabre VIs Ready for Germans

First batch of 225 Sabre VI jet fighters for West German Air Force completed final flight tests at Canadair Ltd. facility in Montreal. The planes have been officially accepted by the Luftwaffe and are being prepared for shipment.

Certificates of Necessity

Washington—Office of Defense Mobilization has awarded Ramo-Wooldridge Corp., Los Angeles, a certificate of necessity for accelerated tax amortization in the amount of $13,418,872 for research and development. Of the amount, 40% was allowed. Other certificates awarded:

Pratt & Whitney Aircraft Division, United Aircraft Corp., East Hartford Conn., jet engines for military aircraft, $4,700,000 with 75% allowed.

Aluminum Co. of America, Vernon, Calif., aluminum extrusion facilities for military aircraft, $4,323,000 with 65% allowed.

General Electric Co., Evendale, Ohio, military aircraft engines, $3,909,950 with 80% allowed.

Briles Manufacturing, El Segundo, Calif., titanium fasteners for military use, $988,924 with 65% allowed.

Boeing Airplane Co., Seattle, military aircraft, $879,592 with 65% allowed.

The Martin Co., Baltimore, military aircraft, $753,152 with 65% allowed.

Boeing Airplane Co., Seattle, military aircraft, $669,246 with 65% allowed.

Kaman Aircraft Corp., Bloomfield, Conn., research and development, $320,000 with 65% allowed.

Eclipse-Pioneer Division, Bendix Aviation Corp., research and development, $249,001 with 65% allowed.

A-N-R Investment Co., Columbus, Neb., electronic equipment for military aircraft, $125,000 with 45% allowed.

Cameron Iron Works, Inc., Houston, Texas, missile components for military use, $558,290 with 40% allowed.

Bendix Aviation Corp., North Hollywood, Calif., military aircraft and missile components, $154,105 with 65% allowed.

Ryan Aeronautical Co., Inglewood, Calif., military aircraft components, $81,325 with 65% allowed.

Ex-Cell-O Corp., Elwood, Ind., military jet engine components, $75,706 with 65% allowed.

Kearfott Co., Inc., Black Mountain, N. C., military aircraft instruments, $2,063 with 65% allowed.

Chatham Electronics Division, Tung-Sol Electric Inc., Livingston, N. Y., military electric components, $159,000 with 65% allowed.

General Electric Co., Palo Alto, Calif., research and development, $134,324 with 65% allowed.

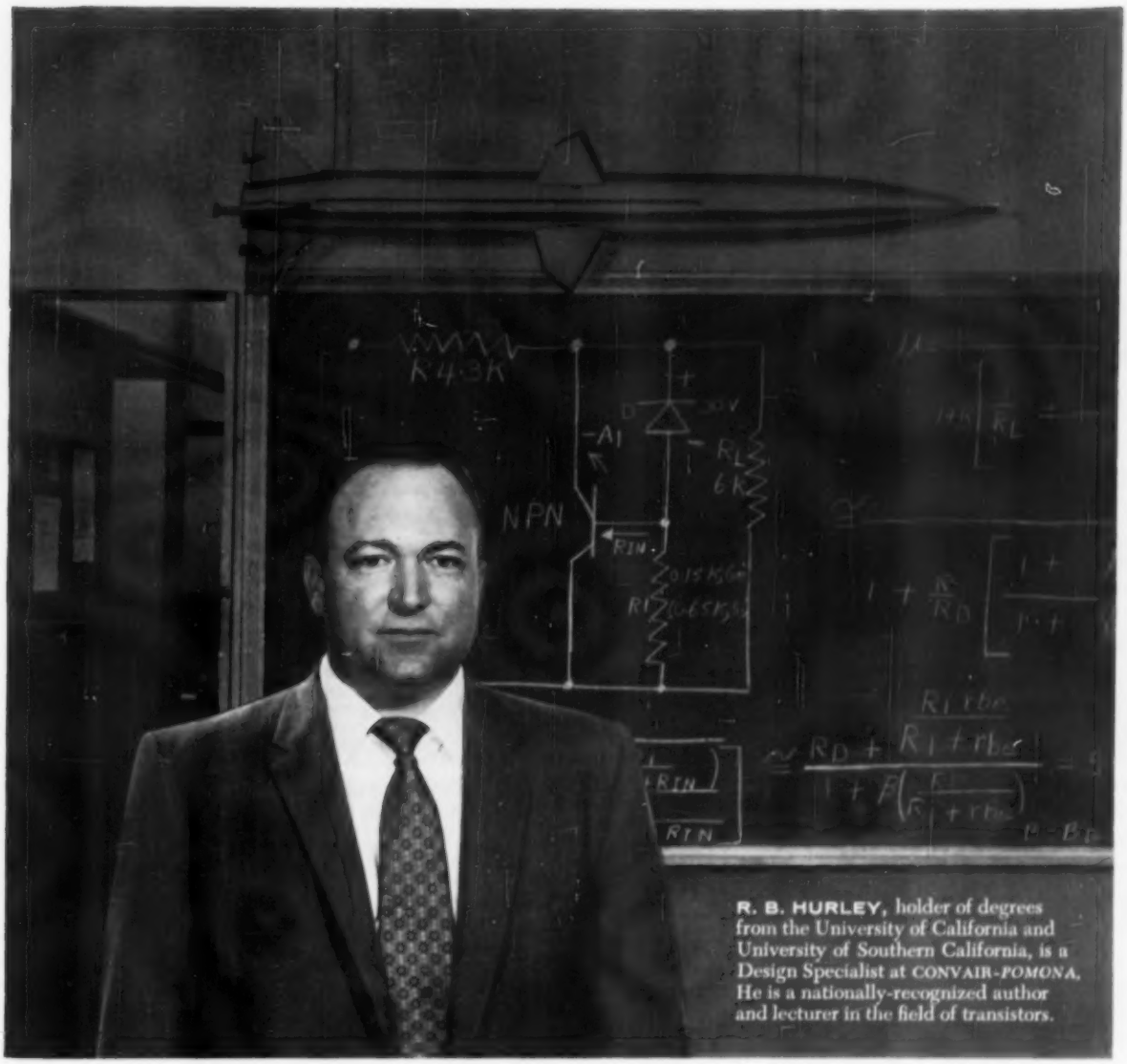
Carco Industries, Inc., Philadelphia, components for military missiles and tanks, $88,000 with 55% allowed.

Kearfott Co. Inc., Van Nuys, Calif., scientific instruments for military use, $1,856 with 65% allowed.

Bell Aircraft Corp., Wheatfield, N. Y., military aircraft, $157,503 with 65% allowed.

Crosley Division, Avco Manufacturing Corp., Cincinnati, electronic equipment for military use, $18,554 with 65% allowed.

Continental Machine Co., Newtonville, Mass., electronic parts for military use, $42,162 with 70% allowed.



R. B. HURLEY, holder of degrees from the University of California and University of Southern California, is a Design Specialist at CONVAIR-*POMONA*. He is a nationally-recognized author and lecturer in the field of transistors.

"Engineers—here's how we're taking part in the electronics revolution toward solid state devices"

"Here at CONVAIR-*POMONA*, we are constantly studying ways to apply the new miniature solid state electronic devices: the diode, rectifier and transistor. So new is this semiconductor infant, and so vast its future – both for the military and industry – that our teams of electronics engineers actually 'go to school' under some of the foremost experts in the field.

"As the *first* fully-integrated missile plant in the U.S., CONVAIR-*POMONA* designs and builds the Navy's TERRIER supersonic missile. And, realizing the potential value of solid state devices in meeting the critical requirements of such airborne missiles, we initiated a 'transistor program' early in 1953. This program has multiplied many times to become one of the most important in the industry.

"You, as an engineer, can appreciate the tremendous expansion that will come in the application of solid state electronic devices in the next few years. And you can readily understand the advantages of studying and working with these devices, guided by the advanced thinking you will find at CONVAIR-*POMONA*.

"You'll like the atmosphere here, where you see and feel accomplishment. And you will enjoy living in Southern California's beautiful Pomona valley. For greater career opportunity – *for your future's sake* – send for more information about CONVAIR-*POMONA today!* Write to: Engineering Personnel, Dept. 3-F."

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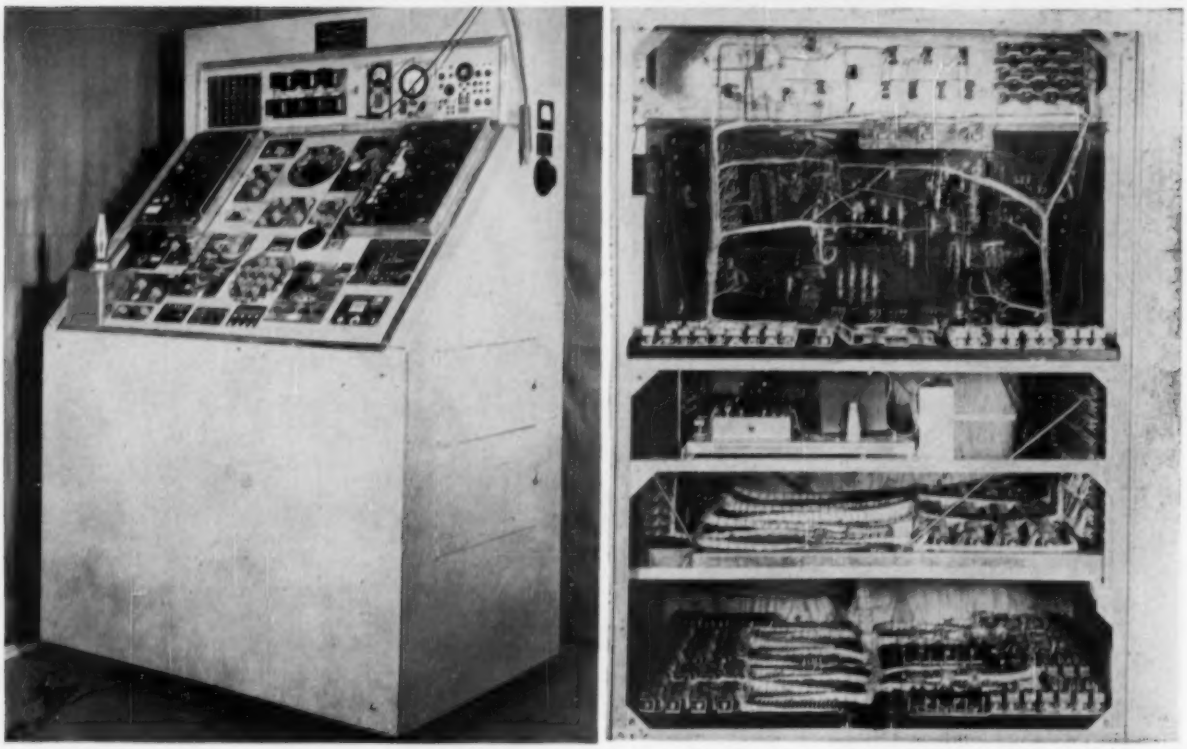

MALFUNCTION and Circuitry Trainer MAC-2 (left), is a relay-controlled, circuit-simulating device built to a MA-7A Bomb-Navigation System configuration. Purpose is to assist a line mechanic to learn MA-7A data flow. Wiring is shown at right.

Report on QPRI: Part II

USAF Probes Systems Maintenance

Lowry AFB, Colo.—Probing into the frontiers of human skills and performance—determining how to maintain a nuclear-powered aircraft by remotely controlled manipulators in one instance—is one of many USAF personnel problems being attacked by the Maintenance Laboratory of the Air Force Personnel and Training Research Center here.

Laboratory Mission

The Laboratory's mission rests on these two overall programs:

• **Technical program** of research into devices, methods and procedures for training, evaluating and utilizing Air Force maintenance personnel—such as introducing manipulators to the flight line.

• **Operational program** for the development of Qualitative Personnel Requirements Information (QPRI) on maintenance and servicing of weapon and supporting systems. Under this program the laboratory has, or is preparing, QPRI reports on 30 different weapon systems. Sixteen have been completed, 14 are in progress.

The 30 weapon systems, and the four catagories into which they fall, are:

• **Missiles**—QPRI has been completed on: GAM-67 Crossbow, GAR-1 Falcon, IM-70 Talos, IM-99 Bomarc. QPRI is in process on: GAM-63 Rascal, SM-62 Snark, SM-64 Navaho, SM-65 Atlas ICBM, SM-68 Titan ICBM, WS-315A Thor IRBM, TM-61B Matador.

• **Fighters**—QPRI completed on: F-89J, F-100, F-101, F-102A, F-104, F-105, F-107. QPRI in process on F-106.

• **Bomber/Cargo**—QPRI completed on: B-52, B-58, C-130, KC-135.

• **Special**—QPRI completed on: Crash locating system. QPRI in process on: WS125A nuclear powered bomber, ground based electronic countermeasures, ballistics missile detection and support system, intelligence data handling, SAGE, TRACALS (traffic control and landing system).

Technical Areas

The five technical areas of maintenance and servicing training in which the Maintenance Laboratory is engaged are:

• **Conditions of efficient learning.** It determines conditions of environment and types of presentations of material which produce the optimum learning and retention curve patterns for maintenance personnel.

• **Characteristics of maintenance** training equipment. Laboratory defines the characteristics of new maintenance training equipment.

• **Measurement of individual** proficiency. The facility attempts to assess the proficiency and knowledge of mechanics on the job in such USAF commands as Strategic Air Command and Tactical Air Command.

• **Aids to job performance.** Laboratory determines what aids are effective to improve job performance and feeds these data into a weapon system's development cycle. Examples are pocket-size, technically-oriented handbooks which the Laboratory is planning for ballistics missile systems. The books describe various missile components, show how the mechanic should keep them in correct operating order. The books are small enough for the man to

take along with him to the job for ready reference.

• **Forecasting maintenance job** requirements. How do you derive a job description that is reliable, understandable and means the same thing to everybody? Another facet of this problem is to predict what maintenance job requirements will be in years to come. Typical example of this type of prognostication is the laboratory's work on how to maintain WS125A—the nuclear powered bomber—with remote control manipulators.

Maintenance by Manipulator

An active program is exploring the manifold problems of how to maintain a radioactive aircraft with manipulators so that the mechanics can be adequately shielded from radiation.

A laboratory technician told AVIATION WEEK that manipulators have been purchased and a research program is being established. Atomic Energy Commission's extensive backlog of experience with manipulators is of little use to USAF because the AEC uses the devices mainly to lift and move objects from one place to another while the Air Force wants to use them to screw and unscrew parts—a totally different set of motions.

Use of manipulators requires special motor skills on the part of maintenance personnel; they also require skill in handling parts remotely in respect to depth perception. To solve this, laboratory technicians are working with three-dimensional color television.

Some of the problems which the laboratory will tackle include:

• **What will be the probable** effects on the time it takes to maintain a nuclear-powered plane if the work is done by manipulator?

• **What limitations can be expected** of highly trained personnel in the performance of maintenance functions with manipulators?

• **What new skills will** be required of maintenance personnel?

• **How much training will** be needed for maintenance mechanics to reach peak performance?

MASTER-SLAVE manipulator being tested in an experimental operation by AFPTRC Maintenance Lab to determine its adaptability to WS125A nuclear-powered bomber.

First step will be to find out the limitations of the machines and determine how to train men to work them.

Missiles Practice

Large missiles—or weapon systems—such as intercontinental ballistics missiles pose severe operational and maintenance problems because there is no precedent on which to base operational and maintenance procedure.

As a laboratory official put it, "Just as would-be surgeons start learning surgery by practicing on cadavers, so are we attempting to learn how to handle new missiles by practicing on older weapon systems. To do this, we retrofit on the old 'birds' inputs which will be used on the new weapon systems to gain as much experience as possible on how to handle them."

The five elements of a training device which should be built into the unit are:

• **Guidance.** Student should be guided to the right response to a question or problem.

• **Feedback.** A man should be shown whether he is proceeding correctly or incorrectly in his maintenance procedure. If he is right, the device should show him he is right; if he is wrong, it should tell him so and indicate what is right.

• **Practice.** Trainer should give a man an opportunity to practice a given procedure whenever necessary.

• **Pacing.** The device should allow a student to pace his training to his own ability and initiative. When suitable proficiency is reached, guidance should be removed and the student allowed to proceed on his own.

• **Evaluation.** The trainer should evaluate a man's progress to show the student how he is doing and to give the instructor a yardstick to measure his progress. Ideally, evaluation should be accomplished automatically and on a permanent record for future use.

Among trainers developed by the laboratory are:

• **Subject Matter Trainer.** The device is used to teach facts, both practical and psychological. If the student is to be given new questions, it gives him guidance to the correct answers. If he should have certain knowledge, it tests his knowledge. It is self-instructional, allowing a student to learn new material by himself, releasing valuable instructors to teach more complex skills. It also allows students to proceed at their own pace.

• **Procedural Trainer.** This device is more practical than psychological. It requires an instructor to work with the student. Advantages of this type of trainer are that it does not use actual

Psychology in Air Force Academy

Starting with the sophomore class, the Air Force Academy will give a course in general psychology. The course will be prescribed. It will be taught in the same manner as it is given in the best colleges but will have an Air Force orientation with a core of technical subject matter. The courses will be taught by invitation by members of the Air Force Personnel and Training Research Center's Maintenance Laboratory at Lowry.

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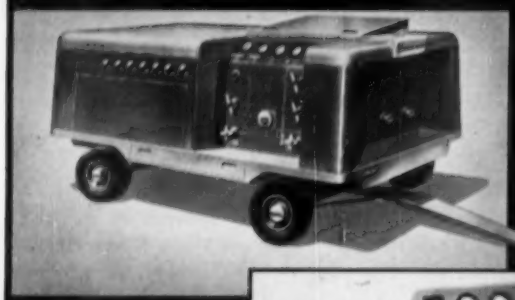

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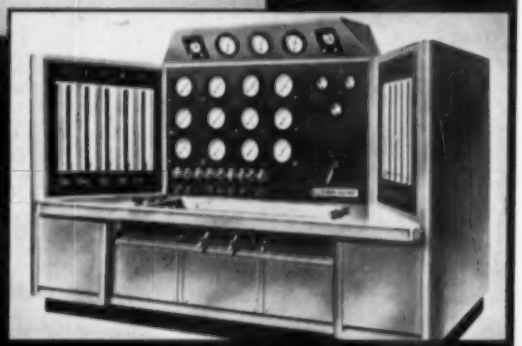

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QPRI-developed booklet helps mechanic trouble-shoot electronic fuel control on an F-86D Sabre fighter.

aircraft electronic systems, they cost 1/10th-1/30th of the total electronic system they teach and they are highly reliable.

Examples of such devices developed by the Maintenance Laboratory are the E-4 fire control system troubleshooting trainer and the K-System bomb-navigation troubleshooting trainer.

Other types of training devices whose use is growing in the aviation industry are:

Part-time or task trainers, made by such companies as Burton Rodgers Technical Training Devices, Carmody Corporation and Stanley Aviation. Also, the comprehensive electronic simulators manufactured by Link Aviation, Curtiss-Wright, Erco and others.

Laboratory technicians are trying to determine how much territory a training device should cover to achieve maximum training effectiveness with a minimum number of trainers? Extreme positions are: Have one trainer for each task, or have one simulator which would incorporate all tasks in one machine.

Job Descriptions

Dr. Robert M. Gagne, Maintenance Laboratory's technical director, told AVIATION WEEK that one of the knottiest problems facing his organization is, "How does one describe a job in such a way that the descriptions are dependable between systems?"

For example: Does the simple instruction, "adjust amplifier," mean the same thing on one system as it does on another? Does it require the same technician behavior on both systems? If not, "adjust amplifier" is not reliable. But then what is?

Another aspect of the problem: the instruction "set in wind drift" can mean anything from a simple knob adjustment to a specific indication to

complex calculations to do the job.

The laboratory is not helped much by traditional job analysis terms or techniques—they suffer from the same defect of imperfection of terms to describe jobs.

Gagne believes that solution to the problem lies in two approaches: reliability of terms and inferring job resemblances and establishing training requirements.

Task Description

He says that, "in terms of reliability, we have arrived at a level of description of tasks within jobs which is reliable. To achieve reliability, the description must:

- "**Use action** words.
- "**Use words** indicating objective of the task.
- "**State what** the specific equipment is.
- "**State what** test equipment is necessary to the task.

"These four elements constitute a job description which is reliable, but which does not accomplish the second part of the problem.

"Inferring job resemblances is important. Some kind of job categorization is essential to determine if certain jobs resemble each other—have a more or less common denominator—so that common training can be given. This, in turn, is cheaper and easier than completely retraining a man for a new task.

"Initially, a new job is usually a blending of known tasks rather than being one for which there is no known precedent.

"Also, 'new jobs' are more likely to occur in the operation of equipment rather than its maintenance and checkout.

Laboratory technicians are trying to develop a set of scientifically acceptable definitions of behavior involved in Air Force maintenance tasks since these constitute inferences about job descriptions.

A pitfall, Gagne pointed out, is the "Global Definition" which tends to overstate a job requirement such as "A helicopter mechanic needs to know the theory of flight."

Easier Maintenance

Dr. Leslie J. Briggs, chief, Training Standards Section, Performance Branch, explained the new MG-10T Aircraft Weapon Control System (AWCS) Radar Procedural Trainer being built for the Air Force and an interesting side-light that resulted.

Contract calls for delivery of the prototype trainer by the end of November. MG-10T is the trainer for the MG-10 AWCS going into F-102As.

The trainer is made of two major components, a radar troubleshooting device and a computer troubleshooting device.

Three types of specialists will be trained on the unit. A data flow specialist, who will have a general knowledge of both the radar and computer portions of the machine; a radar specialist, who knows the radar section intimately; and a computer specialist, concerned exclusively with the computer section.

Each squadron of F-102As will include one or more of each type of specialist.

Interesting sidelight which became apparent during the design stages of the trainer for the highly complex MG-10 AWCS, is that certain trainer features would increase the AWCS's maintainability and could be incorporated in its design with little increase in weight or complexity and with no sacrifice in its operational effectiveness.

Increase in the AWCS's maintainability would be achieved on three fronts: make maintenance easier and more automatic, and give the mechanic more prompting on the job than he had before.

Here are details:

- **Easier maintenance** is achieved by bringing test points in the system's elaborate wiring system out to terminals which are placed near the surface of the aircraft instead of burying them in inaccessible spots in the bowels of the plane.
- **Automation of maintenance** is increased by incorporating modular construction so that a troubleshooter can remove and replace a defective component without having to know how it works or even what it is.
- **Reliability of maintenance** is increased by building more signals into the system to warn a mechanic that he has made an error and keep him from proceeding until it has been rectified. It safeguards against a mechanic thinking the system is operating correctly when it is not.

Briggs says, "Recently, in trying to design a better trainer, engineers came up with implications for a new systems design which would make the airborne equipment more maintainable. This philosophy has just become apparent and should benefit the manufacturer of an AWCS whose complexity is so great that it tends to militate against the system. Any increase in maintainability would be as welcome to the maker as to the user . . . corollary advantage of this new concept is that it can use much of the existing circuitry of the AWCS, thus requiring very little to be added to the system."

Tighter Training

Dr. George B. Simon, chief, Training Equipment Section, Systems Branch, stated that the basic objective of his section is to "make training more efficient, effective and economical through systematic planning to determine the objectives of a training de-

Eisenhower Alights From Helicopter

President Eisenhower is pictured leaving his new Bell 47J helicopter after it landed in clearing near secret command headquarters in Operation Alert. The Bell carried Eisenhower from White House grounds to the secret spot as part of the H-bomb drill on July 12.

vice or of a series of related training devices."

A major problem facing Simon's group is: How much automation should be built into ground check-out equipment for future guided missiles?

If too much is automated, the check-out system may become too expensive to develop and too complex to maintain.

If it is not automated enough, check-out of the system may require too much manpower, individuals may need too much training, and the human element may be taxed beyond its capacity to perform.

Therefore, the laboratory is striving to determine that delicate point where automation and manpower are blended to an optimum degree to produce a ground checkout system of maximum efficiency and reliability.

The Air Force is concerned with efficiency, fatigue and morale of its personnel who are asked to perform dull jobs over long periods of time, yet respond instantly and correctly to an alert.

This situation is exemplified by operators at missile stations who spend long periods of duty, keeping a 24-hour, fire station alert but whose dull duty is to monitor a number of dials and gages. The situation is often aggravated because the men may be isolated in some remote spot, away from family and friends. Such conditions can create acute problems of morale, and to keep such crews operating at top efficiency and reliability on a 24-hour basis is difficult.

Industry Recognition

AFPTRC officials point out that the general problem of human factors is receiving increasing industry recognition.

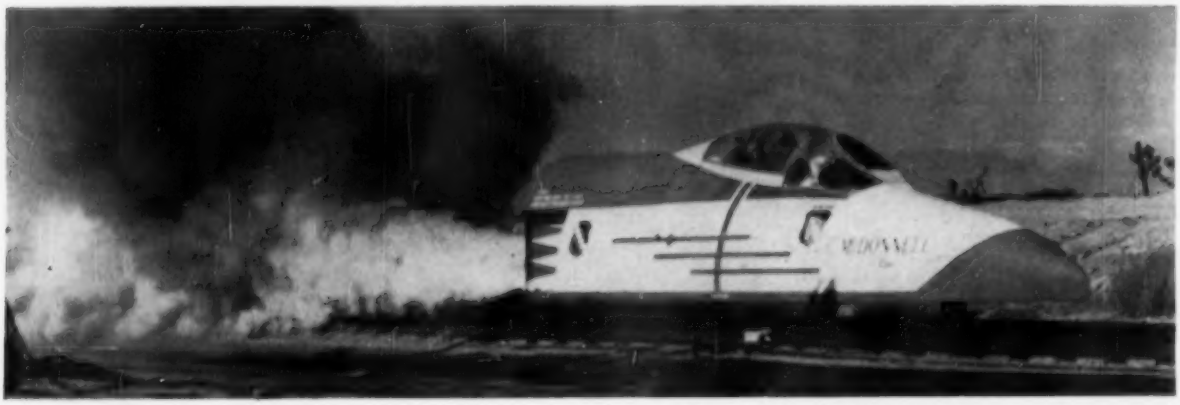
Lockheed used QPRI on its supersonic F-104 Starfighter. Company also uses QPRI at its Marietta, Ga., plant where it is building C-130 cargo planes, and it has a human factors staff working at its Missile Systems Division.

Boeing has just established a new human factors group. Among its first tasks is the development of a system of mechanical "vision" for future aircraft which will fly at speeds exceeding 1,600 mph. The system will practically eliminate the possibility of in-flight collisions, according to Boeing, and will have many other advantages.

As the company points out, if two planes approach each other on a collision course at such speeds, the pilots would only have 10 seconds to alter course if they spotted each other 10 miles away. At such a range, even large aircraft appear as only specks in the sky.

So Boeing has found it necessary to take a new look at airframe design from an operational viewpoint and the human factors group has been handed the job.

Other manufacturers using QPRI are: North American, Downey; Convair, Fort Worth; Northrop; and Hughes, Culver City.



Sleds Used in Tests at Edwards

Two types of rocket sleds are fired at Edwards AFB, Calif. Pointed nose pusher sled (top), powered by a 50,000 lb. thrust Rocketdyne liquid propellant engine, hits water brake at end of 8,000 ft. run. McDonnell sled (below) built by Hunter-Bristol Corp., tests F-101A canopy, ejection seat. It is built of aluminum alloy in conventional aircraft techniques, is powered by 14 solid propellant rockets of 11,000 lb. thrust each.

RADIOPLANE supersonic XQ-4 drone, mounted on wing of a B-50, is undergoing flight tests. It is air launched, recoverable by parachute.

Supersonic Drone Is Evaluated

Los Angeles—Supersonic Radioplane XQ-4 target drone with a ceiling "in excess of 60,000 ft." will be built for USAF under contracts for $3,692,000.

Its primary mission is evaluation of air defense systems. Maker is a subsidiary of Northrop Aircraft and appearance of the XQ-4 indicates that it has some Snark design influence in it.

High aspect ratio, sharply swept wings of Northrop SM-62 Snark are replaced by short, steeply tapered straight wings on the smaller XQ-4 since range is less important in target drone. Straight high aspect ratio slab stabilizer is required on XQ-4 for longitudinal stability and control because of wing change.

Axis of Rolls-Royce Soar turbojet engine slung under tail parallels fuselage rather than being set at negative angle as in SM-62.

The drone is intended to be air-launched but can be ground launched. A three-stage parachute is used to decelerate it in steps during recovery. XQ-4 can carry tracking and scoring aids and photographic and/or television reconnaissance equipment. Radar guidance is used.

Principle dimensions are:

- **Length** 35 ft.
- **Span** 12 ft.
- **Fuselage** diameter 2 ft.

First flight tests at Holloman AFB, N. M., have been successful.

DRONE has sharply pointed nose. Engine, unlike Snark, parallels fuselage (below).

AN INERTIAL SYSTEM WITH SEA LEGS . . .

Vought is shaping inertial guidance for a new role in sea-going missiles

Long-range guidance . . . completely self-contained.

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Ability to handle quick changes in launching position and variations in course . . .

These are capabilities Vought engineers are designing into an inertial guidance system for missiles. In many other ways, too, this project is one of a kind:

- It's a sea and air venture, involving the compatibility of guidance system with missile, and of missiles with ships.
- It will reach its climax on a vast proving ground, ranging from the North Atlantic to the South Pacific.
- It will require the systemization of components much more sensitive than present-day systems require.
- It will necessitate the most advanced development facilities, including flight test aircraft instrumented for inertial guidance, and the Navy's extensive equipment for navigation research.

And perhaps most important to the engineer — development, design, systems work, flight and sea tests will all be directed by Vought engineers.

These men introduced Regulus I, the Navy's only surface-to-surface missile with a 600-mission record. They developed the supersonic Regulus II, around which a new generation of submarines is being designed.

Watch for progress reports on their newest program. Better yet, if you're an engineer—join them!

Vought's recoverable flight test vehicles, like this Regulus II, have preserved invaluable guidance data while registering savings to the government and the taxpayer of almost $100,000,000.

Vought's Regulus II — newest sea-going missile — will serve as primary weapon in Navy's nuclear fleet.

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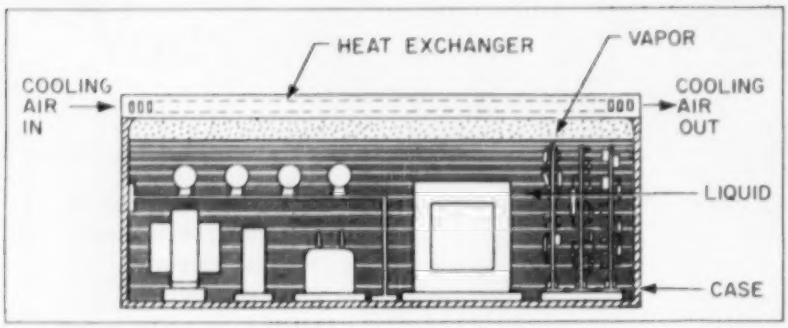
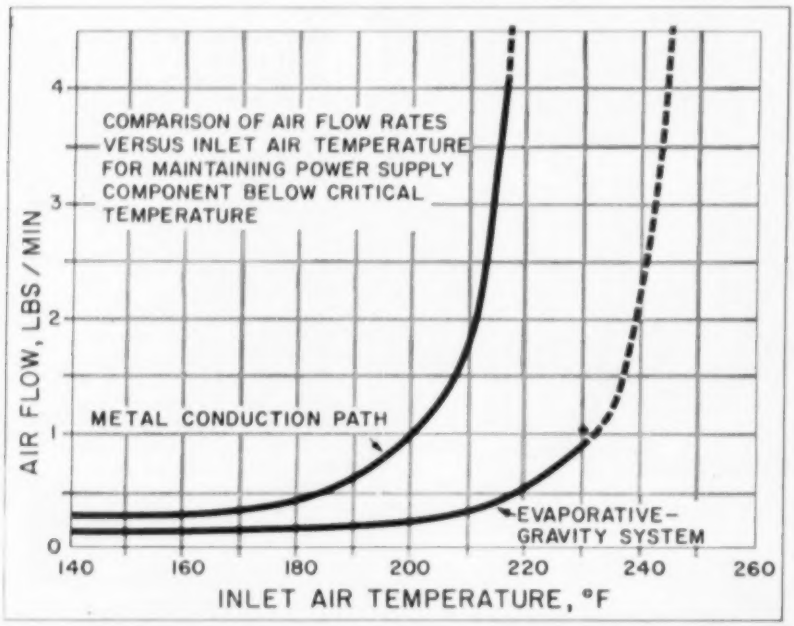
Vapor-Gravity Boosts Avionic Cooling

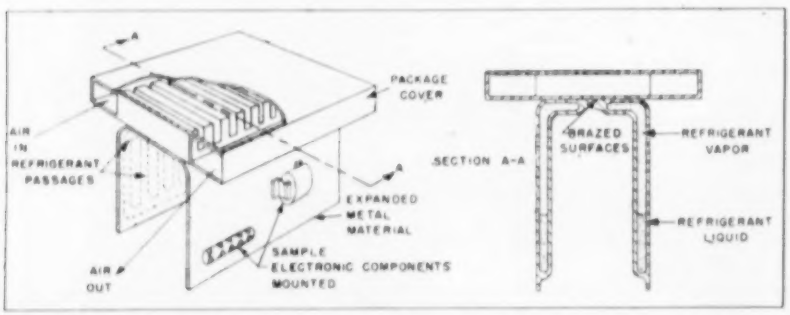
By Philip J. Klass



EVAPORATIVE-gravity cooling technique, developed by Raytheon, immerses avionic components in freon sealed in chassis with heat exchanger mounted on top. Component heat vaporizes liquid which rises to heat exchanger where it gives up heat, condenses, returns.



COMPARISON of evaporative-gravity cooling and conventional metal conduction showing air flow versus inlet air temperature to maintain critical component temperature.



ALTERNATIVE design, combines evaporative-gravity cooling and metal conduction techniques for equipments where it is not feasible to immerse components in liquid.

Washington—New approach to cooling avionic equipment, which reduces amount of cooling air required by 50% or more and permits more compact equipment construction, stirred considerable interest here at the recent Military Electronics Convention.

Called Evaporative-Gravity Cooling, or "ev-grav" for short, the technique was developed by Raytheon and reportedly will be employed in the modulator of a new airborne radar under development. The technique was reported by Dr. Melvin Mark, consulting engineer, in a paper co-authored by Mark Stephenson and Costas Goltsos, both of Raytheon's Wayland (Mass.) Laboratory.

The technique employs simple evaporation and condensation of a liquid to transfer avionic component heat to a heat exchanger (cooled by air) instead of conventional metal conduction paths between components and heat exchanger.

The result, Dr. Mark said, is a far more efficient transfer of avionic component heat to the exchanger (and cooling air) and near-equalization of the temperature of all components, eliminating hot-spot problems.

Gravity Assist

In a typical configuration, the avionic equipment is mounted in a sealed case with the heat exchanger mounted on top. The case is evacuated, then filled with a liquid to a level which fully immerses all of the internal components, leaving at least a small unfilled area between the top of the liquid and the heat exchanger.

The heat transfer fluid employed is a freon refrigerant or fluorochemical but it does not perform in the familiar refrigeration role. Instead, heat from the avionic components immersed in the liquid causes it to vaporize, carrying off the heat. The vapor rises under its own pressure, comes into contact with the heat exchanger, gives up its heat to the exchanger and condenses into liquid again.

Gravity returns the condensed liquid to the pool below and the cycle is repeated.

This provides a very efficient transfer medium because the vapor is uniformly distributed over the full area of the exchanger, Dr. Mark points out.

To compare the cooling efficiency of the new system with metal conductive paths commonly used, Raytheon built

two power supplies. One used the ev-grav technique, the other metal conduction. The power supplies included a transformer with maximum allowable internal temperature of 180C, a choke coil with maximum surface temperature of 180C, silicon diodes rated for 135C, a relay designed for 130C and a capacitor for 125C. The capacitor was the critical component insofar as allowable temperature rise.

The conventional design had its components mounted directly onto the heat exchanger (cold-plate) in the base using metal clips and bands. The ev-grav model was filled with F-114 refrigerant and its heat exchanger was located on top.

Cooling Comparison

Tests revealed that at low cooling air inlet temperatures, around 140F-160F, the conventional design required twice as much cooling air (flow rate) as the ev-grav unit for equivalent component temperatures. At higher inlet air temperatures, around 200F, the ev-grav system had a 4:1 advantage in inlet air flow rate.

When inlet air temperature exceeded 224F, no amount of cooling air could keep the components below their peak temperature limits with conventional metal conduction whereas the ev-grav system could do so with inlet air temperatures up to 255F, Dr. Mark reported.

The ev-grav cooling tends to minimize the temperature differential between individual components as well as between a component's internal and surface temperature. For example, the temperature differential between the transformer primary coil and its surface was only 12F with ev-grav cooling, compared to a 34F differential with conventional design.

Weight Comparison

The foregoing ev-grav advantage was achieved despite the fact that the unit was constructed in a smaller container (25% less volume) than the conventional counterpart, giving higher heat density.

The high dielectric strength of the refrigerant, Dr. Mark said, makes possible closer component spacing.

A comparison of the dead weights of the two power supply units shows that the conventional design, at 5.45 lb., was about a third lighter than the ev-grav unit at 7.73 lb. The increased ev-grav weight stems from the refrigerant and the need for reinforced container walls.

However the comparison of dead weights does not take into account the weight of equipment which must be added to an airplane to supply cooling air.

Approximately 13.7 lb. of extra aircraft weight is added for every pound-per-minute of cooling air supplied at 180F, Dr. Mark says. When this factor is multiplied by the air flow rate required and this is added to the device's dead weight, the result is what Dr. Mark calls total equivalent weight, or TEW, and this he believes should be the basis for comparison.

For an air inlet temperature of 180F, 0.185 lb./min. will be required by the ev-grav cooled power supply, compared to 0.46 lb./min. for the conventional unit, to maintain the critical (capacitor) temperature below 125C. This works out to give the conventional unit a TEW of 11.8 lb., compared to only 10.3 lb. for the ev-grav design, or a 13% weight saving for the latter.

At higher inlet air temperatures, the ev-grav weight advantage goes up. For example, if cooling air inlet temperature is 208F, the TEW of the conventional design is 29.5 lb., compared to only 12.5 lb. for the ev-grav design, Dr. Mark said.

Technique Limitations

The ev-grav system of cooling adds little complexity because it does not require a pump to circulate the liquid-vapor, relying upon self-generated vapor pressure and gravity. However, the technique does pose certain design or operating problems:

- **Liquid must be compatible** with materials used in components. Suitable freons or fluorochemicals are available, the authors indicated.
- **Components must be hermetically sealed** or unaffected by presence of the liquid.
- **Equipment can not operate inverted** for extended periods of time or at tilt angles sufficient to disrupt the flow of vapor to the heat exchanger and return of the condensate. However, the liquids used have sufficient thermal inertia to absorb component heat for short periods of inverted flight or high tilt without generating dangerously high pres-

Early Warning Blimp Flies

First flight picture of Goodyear early warning ZPG-2W blimp shows housing for plate on top of bag which supports bedspring type antenna (AW June 10, p. 88). Antenna itself rotates inside bag. Double deck car slung underneath carries flight deck, radar scope room, engine room tanks and crew quarters. Blimp's advantages for warning missions are low fuel consumption and roomier quarters.

MICRO SWITCH . . . FIRST IN PRECISION SWITCHING

New MICRO SWITCH "ROCKET SWITCH"... small, rugged, sealed, operated by the rocket as indicating or lockout device

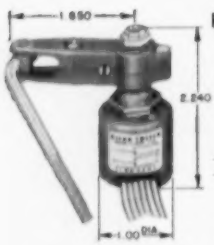
A new development of MICRO SWITCH Engineering in cooperation with missile and rocket launcher designers.

This MICRO SWITCH Type 21AS2 "Rocket Switch" is designed for use on missile and rocket launchers. It may be used anywhere a rugged, sealed, small switch is required for an indicating or lockout device.

The assembly is environment-proof and successfully resists corrosive propulsion gases and normal adverse conditions found in exposed locations of high speed aircraft.

The assembly uses one SPDT EN switch attached to a rugged cam type actuator. It is small and compact and can be located in extremely limited space. The 1EN33 switch used conforms to MS24331-1.

CHARACTERISTICS—Operating force—6-12 lbs. Full overtravel force—10 lbs. min. Release force—4 lbs. min. Break distance—.010 in. min. Electrical data: 28 vdc rating at sea level: inrush 24 amps., resistive 4 amps., inductive 3 amps., motor 4 amps. 28 vdc rating at 100,000 feet: inrush 24 amps., resistive 4 amps., inductive 2 amps., motor 4 amps. (Altitude ratings established with seal deliberately broken.)



Rugged construction insures reliability of EN Series environment-proof switches

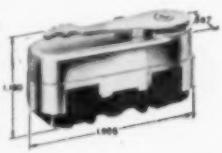
MICRO SWITCH EN Series Switches are small, lightweight, environment proof and easily mounted in difficult locations. They are available with a wide variety of actuators and mechanical and electrical characteristics.

The MICRO SWITCH Type 41EN1-6 (shown) is a rotary-actuated, positive drive switch for linkage-type actuation. Because there is no return spring the driving mechanism must control shaft movement. This positive drive insures actuation and release under the most adverse environmental conditions of ice and dirt.

CHARACTERISTICS

Differential travel—12° max. Free position—35°. Weight—2¼ oz. Electrical data: 28 vdc rating at sea level: inrush 24 amps., inductive 3 amps., resistive 4 amps., motor 4 amps. 28 vdc rating at 100,000 feet: inrush 24 amps., inductive 2 amps., resistive 4 amps., motor 4 amps. (Altitude ratings established with seal deliberately broken.)

MICRO SWITCH HS switch has a true hermetic seal to insure constant reliability



MICRO SWITCH HS Series of precision switches is designed for aircraft applications where constant operating conditions must be maintained regardless of changes in atmospheric conditions.

The switching element is sealed in a gas-filled chamber. This has been evacuated and filled with dry inert gas under pressure. Conductors from the switching chamber to the terminals are sealed in glass. The switch is operated by a "wobble fram" actuator. The switch shown (type 1HS1) is qualified as MS25011-1. HS switches are also available with roller lever and leaf actuators.

CHARACTERISTICS

Operating force—10-22 oz. Release force—4 oz. min. Overtravel—.010 in. min. Differential travel—.020 in. max. Weight—1.5 oz. Electrical data: 28 vdc rating: inductive 10 amps., resistive 25 amps. 125 vac rating: inductive 1 amp., resistive 1 amp.

For complete information on MICRO SWITCH precision switches for aircraft send for Catalogs 77 and 78.

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Passive Radar Reprints

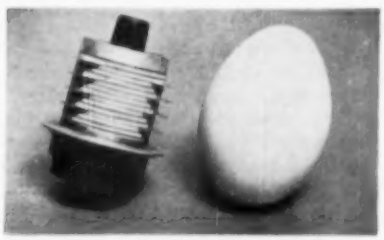
Reprints of Aviation Week's exclusive report on passive radar (July 1, p. 62), the fundamentally new technique for surveillance, mapping and guidance that resembles both infrared and conventional radar in some respects yet offers certain advantages over each, will be available shortly. Price is 25 cents per copy; in quantities of 100 or more, 20 cents per copy. Address requests to: Editor, Aviation Week, 330 West 42nd St., New York 36, N. Y.

sures or temperatures, Dr. Mark indicated.

Where avionic components cannot stand immersion in a liquid, or where such immersion would seriously handicap subsequent maintenance, the authors suggested a configuration which would keep the components dry, yet achieve some of the advantages of ev-grav cooling.

This is an inverted U-shaped chassis, with heat exchanger mounted on top. The U-shaped chassis has hollow passages, running from the base to the heat exchanger, which are partially filled with the refrigerant liquid. Components are then mounted to the U-shaped chassis walls, transfer their heat by conduction to the chassis walls and by conduction from the walls to the liquid.

Dr. Mark, a consultant on heat transfer and avionic cooling problems, has offices at 1384 Massachusetts Ave., Cambridge 38, Mass.



Missile Relay Tested for High Temperature

Ceramic-encased relay of the vacuum type for missile use, reportedly able to operate at temperatures up to 175C and withstand a 50G shock of 11 millisecond duration without contact chatter, has been developed by Jennings Radio Manufacturing Corp.

New ceramic design incorporates advantages of previous glass-enclosed vacuum relays, i.e. less contact burning, faster arc extinction, rapid recovery of dielectric strength, but can operate at much higher temperatures. New relay comes in two models: RA1 is SPDT type, RA4 is 4PDT type.

Here are highlights of the new relay's specifications quoted by manufacturer:

- **Rated contact voltage:** 300 v.a.c. or d.c.
- **Internal dielectric strength** between contacts: More than 5,000 v.
- **Contact current rating:** 25 amps rms. continuous for 40C rise.
- **Operating (solenoid) voltage:** 18 to 32 v.d.c., also 115 v.d.c.
- **Pick-up time:** 20 milliseconds.
- **Release time:** 20 milliseconds.
- **Solenoid power consumption:** 2 watts at 28 v.d.c.
- **Contact resistance:** Less than 0.01 ohms and will not increase with storage or use, according to manufacturer.
- **Vibration resistance:** No contact chatter at 0.15 in. (double amplitude) excursion from 5 to 55 cps.; 30 Gs from 55 to 2,000 cps.
- **Mechanical life:** 1,000,000 operations in vertical plane; 500,000 in any other plane.

Manufacturer cites following life tests which it has performed on new relay without any failures:

- **100,000 operations** at 10 amps, 28 v.d.c., resistive load.
- **500,000 operations** at 2 amps, 115 v.d.c., resistive load.
- **1,600,000 operations** at 0.25 amps, 300 v.d.c., resistive load.
- **3,233,000 operations** at 0.04 amps,

Capt. Lionel Cosse, Capt. André Lesieur, Paul Comet, Navigateur, and Jacques Vergine, Flight Engineer, make up the Air France crew selected to present the Caravelle to the United States aviation industry and public.

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Today's air pioneers wear the stripes of Air France. These are the men who have been chosen to present the new jet Caravelle to the U.S. public and aviation industry. All have jet operational experience in both Caravelles and Comets. This will be invaluable in Air France's change-over to jets – Caravelles on medium range routes in Europe and Asia...and Boeing 707's transatlantic. They are pioneering toward a future that will see a continuing record of dependable Air France service to the peoples of the world.

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NEW WEAPON, NEW CONCEPT

An important new weapon for a new U. S. Army concept is now being delivered in quantity by Martin-Orlando. This is LACROSSE, a field artillery guided missile, developed to implement the combat concept of the Pentomic Army . . . a "fighting" Army consisting of self-sufficient highly mobile battle groups. LACROSSE will provide these battle groups with the shockpower of extraordinary speed, mobility and accuracy in heavy armament support of their operations. LACROSSE is the first generation of an entirely new kind of general purpose weapon. All of its components, consisting of the missile mounted on a standard Army truck and a guidance system, can be airlifted to advance areas. The missile is fired in the general direction of the target—without target data at the launching site. Its pinpoint accuracy is controlled by a forward observer. The Martin Company, with more than 10 years of design, production and operational experience in guided missiles, today stands as a leader in this important field.

MARTIN

BALTIMORE DENVER ORLANDO

Combined Omni

VOR panel indicator, Model 4080, provides rotatable azimuth card for selecting desired omni bearing, with index above and reciprocal heading below, vertical deviation indication needle and to-from arrow indicator. Model 2372 has transistorized omni-converter, for operation with any VHF receiver covering VOR band, built into indicator. Manufacturer: LearCal Div., Lear, Inc., Santa Monica, Calif.

115 v.d.c. inductive load.

• **100,000 operations at** 60 amps inrush, 15 amps steady state, 28 v.d.c. (such as might be encountered in starting up an inverter.)

Jennings Radio's address: 970 McLaughlin Ave., San Jose, Calif.

Expansions, Changes In Avionics Industry

Beckman Instruments, Inc., has formed new Systems Division to handle anticipated three-fold increase in company's data processing systems. New division, with headquarters and manufacturing facilities at Anaheim, Calif., and a plant at Richmond, Calif., consolidates facilities and engineering formerly part of Beckman's Berkeley and Scientific Instrument divisions. John F. Bishop heads new division.

Other recently announced expansions and changes in the avionics industry include:

• **United Control Corp.**, Seattle, has taken option on 30-acre site for new plant which it hopes to have in operation by 1960. Company makes aviation control systems.

• **Northam Electronics, Inc.**, is new name of the former **North American Instruments, Inc.**, Altadena, Calif., manufacturer of instrumentation and data processing equipment.

• **Daystrom, Inc.**, has established new Canadian subsidiary, Daystrom, Ltd. and says it will build manufacturing facility in the Toronto area.

• **Raytheon Manufacturing Co.** will add another 20,000 sq. ft. of space to its present 100,000 sq. ft. Maynard, Mass.

T/I electronic systems

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TI-built guidance and control systems fit into extremely cramped quarters aboard many of the latest U. S. missile types. Using advanced miniaturizing methods and rugged TI semiconductors, Texas Instructments is playing an important role in the creation of missiles that fly farther and faster . . . with greater payload and reliability.

Whatever the assignment, Texas Instruments is delivering precision systems that save weight, space and power . . . including audio, sonar, radio, radar, infrared, and other systems for detection, navigation, fire control, and communications *as well as* missile control. With a half-million sq ft of plant facilities in an excellent dispersal area and with over a quarter-century experience, TI is prepared to build virtually any electronic or electromechanical system to the most strict military specifications . . . within a reasonable lead time.

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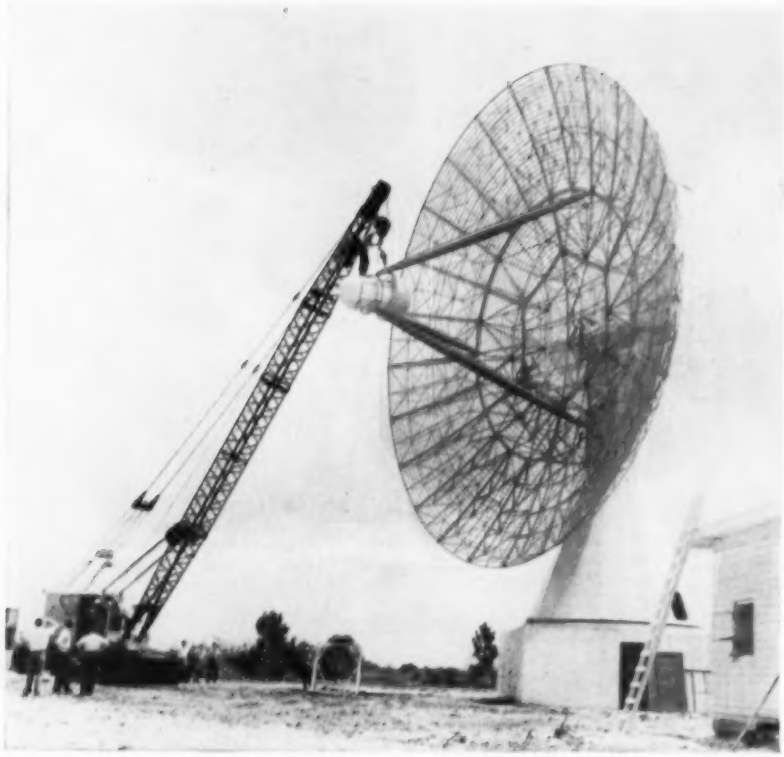


ICBM Tracker

TLM-18 telemetry antenna for automatic tracking of test-fired ICBMs is installed at Melbourne, Fla. First of five being built for USAF by Radiation, Inc., antenna is 60 ft. in diameter and stands higher than a four story building. Secondary use may be for tracking of earth satellite. Other installations are to be at Cape Canaveral, Antigua, Ascension Island and Fernando de Noronha.

laboratory, part of its Government Equipment Division.

• **Bendix Aviation Corp.** has licensed Thorn Electrical Industries of Britain to manufacture its multi-pin connectors for aircraft-missile use.

• **Mid-Continent Manufacturing, Inc.,** Manhattan Beach, Calif., will manufacture, market and service electronic test instruments and automatic data recording systems developed by Fairchild Engine & Airplane Corporation's Electrotechnics Division under recently signed agreement.

• **Avion Division of ACF Industries, Inc.,** has consolidated its facilities with occupancy of third building in Paramus (N. J.) Industrial Park off Route 17. All of firm's activities are now centered here except for group at its original 20,000 sq. ft. site about one mile east on Route 17.

• **Consolidated Electrodynamics Corporation's Spectron Division,** Monrovia, Calif., has purchased optical production and testing equipment of Testa Mfg. Co., El Monte, Calif.

• **Babcock Radio Engineering, Inc.,** has opened new 25,000 sq. ft. facility at Costa Mesa, Calif., consolidating its activities in the one location. Company produces drone guidance and ground support equipment.

• **Techniques, Inc.,** has expanded facilities of its Printed Circuit Division, Hackensack, N. J., for sample and short-order runs of etched circuitry.

FILTER CENTER

▶ **Extending Radar Range**—Video integration techniques which permit a 50-100% increase in range of track-while-scan radars are described in report titled Radar Video Integrator Study, by Roy W. Hendrick, Cornell Aeronautical Laboratory, Buffalo, N. Y.

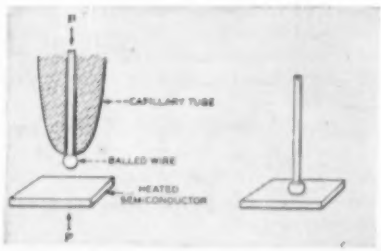
▶ **Transistors Up, Tubes Down**—Semiconductor industry sold nearly nine million transistors during first five months of this year, more than twice the 3.6 million sold in same period last year, according to figures released by Radio-Electronics-Television Manufacturers Assn. Receiving tube sales for same period were down slightly from last year, 185.8 vs. 188.6 million. Total transistor dollar volume for first five months was $25.1 million versus $10 million in 1956. Receiving tube volume for comparable period was $159.1 million (1957) vs. $152.7 million (1956).

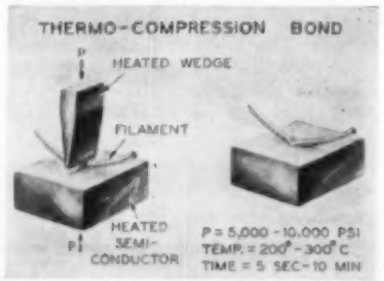
▶ **Tips For Designers**—New Air Force guidebook for avionics designers provides data for estimating the effects of vacuum tube operating temperatures, heater voltages, and other variables on tube life and reliability. The 91-page report, identified: PB 121798, Electron Tube Operation as Influenced by Temperature and Voltage, by T. H. Briggs of the Wright Air Development Center, is available for $2.50 from Office of Technical Services, Dept. of Commerce, Washington 25, D. C.

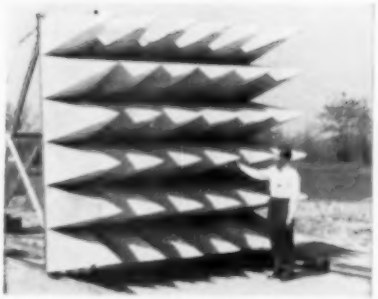
▶ **AC To Spark Regulus**—AC Spark Plug division of General Motors is developing inertial guidance system for use in the Chance Vought Regulus II surface-to-surface missile. AC also is producing inertial systems for the Martin Matador and has just received a $38 million contract for inertial guidance equipment for the Thor intermediate range ballistic missile.

▶ **Push To Bond**—Radically new technique for attaching tiny leads to transistors and diodes which requires only moderate heat and pressure has been developed by Bell Telephone Laboratories.

When wire is pressed against silicon or germanium crystal with force of few thousand pounds per square inch, using a heated wedge, flat or point, it is firmly bonded to crystal in matter of seconds, BTL reports. Another approach uses lead with ball-shaped tip, applied under pressure using a capillary tube. (See photos.) New "thermo-compression" process, whose basic operating mechanism is not fully understood, pro-







Radio-Radar Absorber

New absorbing material, called Eccosorb CHW 560, for use in free-space rooms, reportedly reflects less than 2% of incident energy at all frequencies above 50 mc. Manufacturer: Emerson & Cuming, Inc., Canton, Mass.

vides a number of advantages, according to BTL:

- **Stronger bond**—stronger than the lead itself.
- **Readily adapted to mass production.**
- **Requires no chemical flux** which can contaminate crystal.
- **Permits more accurate lead positioning,** an important factor in improving transistor high frequency response.

▶ **Flight Directors For Jets**—Five major airlines have ordered Collins FD-105 Integrated Flight Systems (IFS) for use in their new jets and turboprops. These include: Braniff for its Boeing 707s and Lockheed Electras; Continental for its Vickers Viscounts; Eastern for its Douglas DC-8s and Electras; Western for its Electras and Trans-Canada for its DC-8s and Vickers Vanguards.

▶ **Biggest One Yet**—Universal Transistor Products Corp., New York City, says its General Services Administration award for 50,000 to 62,500 transistorized radiological survey meters and dosimeter chargers is "the largest contract for transistorized products ever awarded by the government." Amount of the contract is $863,790.

▶ **CAA Buys High-Speed Teletype**—Civil Aeronautics Administration has ordered high-speed teletypewriters capable of operating at 100 words-per-minute for installation in its three aeronautical weather networks. The $3.7 million order was placed with Teletype Corporation of Chicago. New equipment will be installed at all CAA air traffic control facilities, Weather Bureau offices and military base weather offices.

▶ **West Coast Share**—Electronics industry in Los Angeles area now makes up 11.2% of total number of U.S. electronic firms in 1956, produced 15% of the industry's output, according to sur-

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Inspection by microscope, seeking welding faults, minute cracks in glass, and even infinitesimal loose particles inside the tube.

And tubes are only one concern. *All* components must pass similarly rigid tests, to assure operating performance, ruggedness and reliability in the completed equipment.

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S-C

STROMBERG-CARLSON COMPANY

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General Offices and Factories at Rochester, N. Y.—West Coast plants at San Diego and Los Angeles, Calif.

GD

Infrared Gem

Synthetic sapphire, nearly three inches in diameter, produced by Linde Air Products Co. for infrared applications. Sapphire has high IR transmission out to about six microns, can be operated at extremely high temperatures and has good thermal shock properties.

vey by West Coast Electronic Manufacturers Assn. Survey shows that West Coast electronics companies (in 11 states) constitute 15% of nation's total and last year produced 24% of electronic industry's total output. San Francisco area electronics industry expects to increase 1956 plant capacity by 50% (3.5 million sq. ft.) and sales by 41% this year, WCEMA survey indicates.

► **RCA Transponders To CAA**—Civil Aeronautics Administration has ordered 20 of Radio Corporation of America's AVQ-60 air traffic control transponders, for early 1958 delivery, to be used in CAA operational evaluation of ATC beacon system.

NEW AVIONIC PRODUCTS

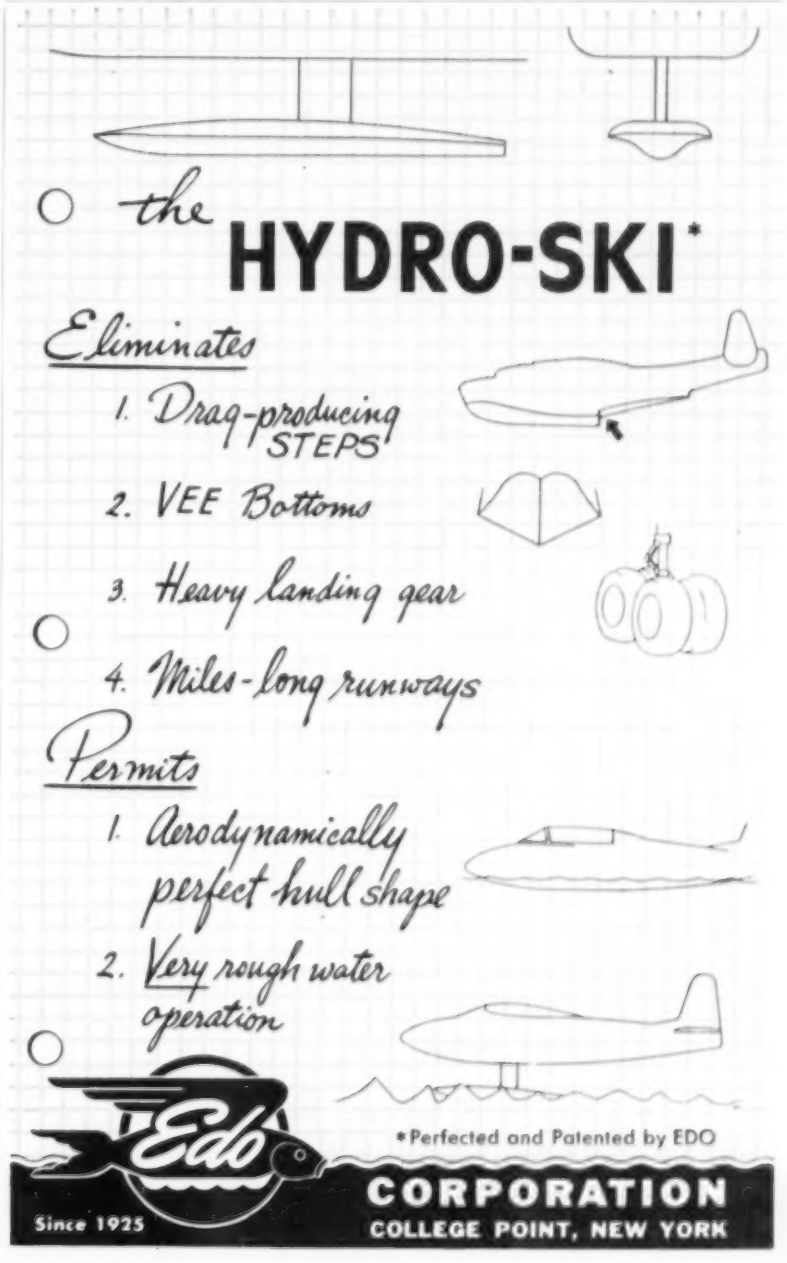
Components & Devices

• **Potentiometer pick-off accelerometer,** Series 4202, for automatic control and flight testing, provides dual or single pot and/or switch pick-offs. Available in a variety of G ranges, unit is equipped with automatic caging and off-neutral test signal features. Accuracy for most ranges is ±1%. Manufacturer is Pacific Scientific Co., P. O. Box 22019, Los Angeles, Cal.

• **Metal-film resistors,** Series 850, offer low noise and low resistance values with very low reactive impedance component, and are capable of operation from −65C to 150C. Resistors are hermetically sealed in three sizes in ohmic ranges from 2 ohms to 4 megohms in accuracies from ±0.5% to ±5%. Manufacturer: Daven Co., Livingston, N. J.

• **Magmeter frequency detector,** Type F-5116, operates from 0 to 10 kc. for use with instantaneous pulse rate indicators, electronic tachometers, direct-reading frequency meters and automatic speed controls. Unit produces 1 ma. full-scale output linear within 1% of full scale. Changes in input voltage from 105 to 135 volts produce about 1% change in indicated frequency. Manufacturer: Airpax Products Co., Fort Lauderdale, Fla.

• **High-temperature servo motor,** Type 8-5001-02, for 400 cps features continuous duty for transistorized operations. Unit measures 0.863 in. by 0.75 in. OD, weighs 1.2 oz., operates from −65°C to 125°C and meets MIL-R-5272. Voltage is 40/20 on control



New QUAKER hose for starting jet engines . . . fast!

Synthetic fabric jacket and silicone tube retain temperatures from upstream to downstream end

Made in continuous lengths up to 50', this new Quaker hose easily withstands temperatures as high as +450°F; as low as −80°F.

As the above diagram shows, the hose keeps heat loss—and therefore energy loss—to a minimum. (Comparable outside temperature of ordinary hot air ducting material, such as stainless steel, would be about 400° F.). Both the silicone tube and the synthetic fabric jacket of Quaker's new hose hold the heat!

Other advantages? The hose is lightweight and fully flexible. And it resists abrasion.

Available in either single or double jacket, the hose comes in 1" to 4" I.D.'s. Sizes 1" and 1¼" I.D. can be made in 30' continuous lengths; 1½" to 4" I.D. in 50' lengths. The hose takes regular expansion and shank hose couplings.

Want more information? Write to: *H. K. Porter Company, Inc., Quaker Rubber Works, Philadelphia 24, Pa. or Pioneer Works, Pittsburg, Cal.*

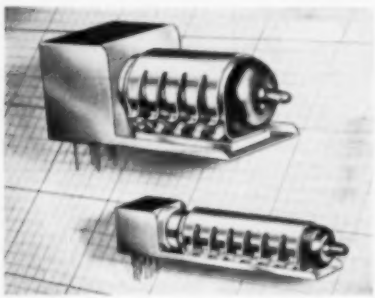
QUAKER RUBBER DIVISION

H. K. PORTER COMPANY, INC.

phase and 26 on fixed phase. Motor has no load speed of 6,500 rpm. and stall torque of 0.15 oz. in. Manufacturer:

John Oster Mfg. Co., Avionic Division, 1 Main St., Racine, Wis.

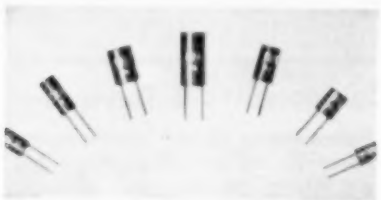
• **Right-angle tube shields,** with integral sockets for miniature and subminiature tubes, provide heat dissipation for printed circuit applications. Standard Mica-filled sockets are cast to shield



assembly in Mica-filled epoxy resin capable of continuous operation at 175C.

Right-angle mounting permits use of heat sink or duct cooling. Shield is manufactured by International Electronic Research Corp., 145 W. Magnolia Blvd., Burbank, Calif.

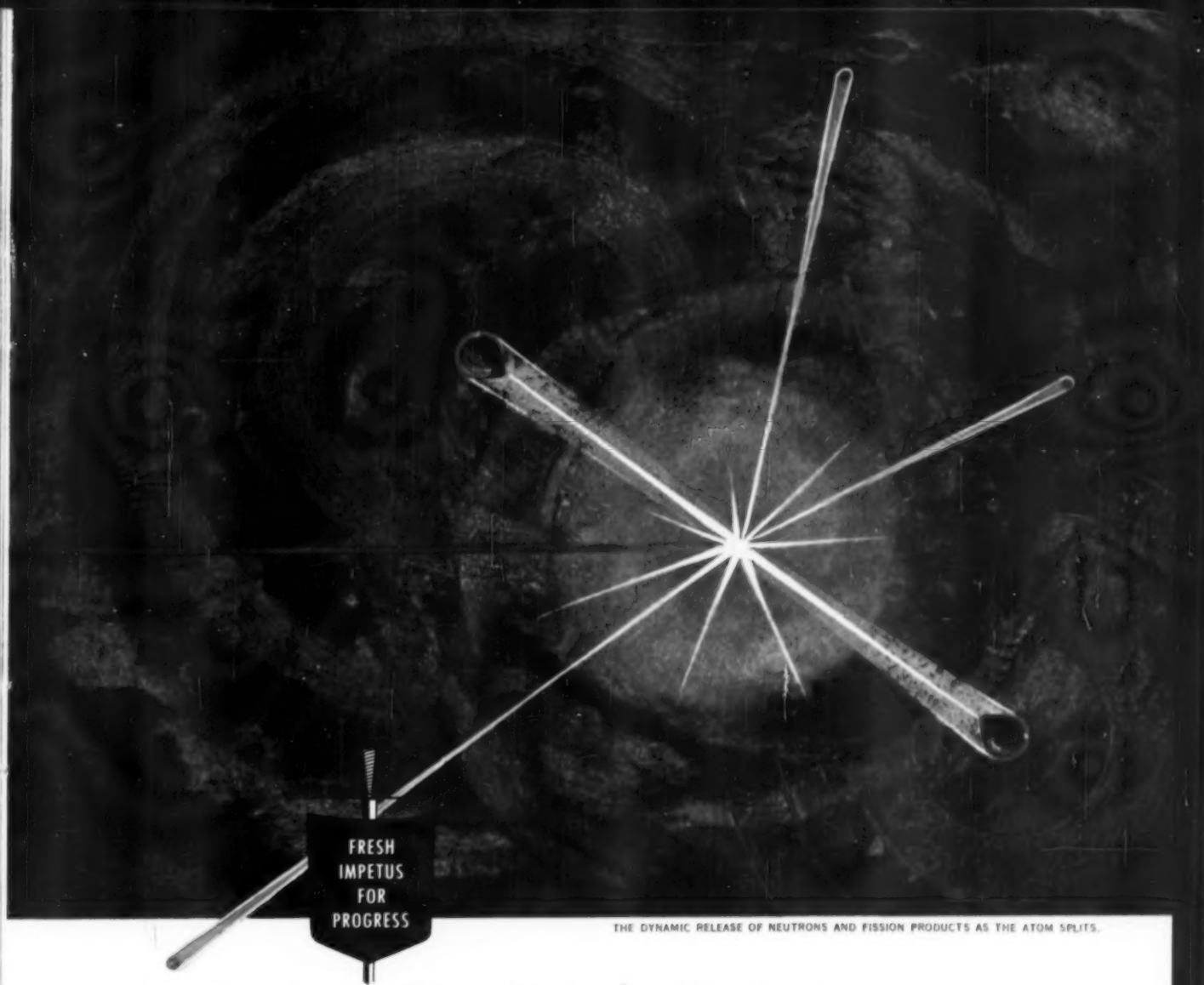
• **Flat-top resistors,** Type P, are single-ended miniatures available in seven sizes from ¼ in. x ⅜ in. to ⅜ in. x ¾ in. with ratings from 0.1 to 0.4 watts. Designed for direct mounting on printed circuit panels, resistors are obtainable in values to 3 megohms and



operate in ambient temperatures to 125 C. Tolerances are from 1% to 0.02%. Type P resistors reportedly meet applicable tests of MIL-R-93A, Amndt. 4, and are manufactured by Resistance Products Co., 914 S. 13th St., Harrisburg, Penna.

• **Digital coder,** constructed entirely on printed circuit boards, operates at 24,000 samples/sec. with a bit rate of 264 kc. Ten-bit coder will digitize one channel of analog voltage with a frequency response of 12 kc. or perform multichannel digitizing in conjunction with a multiplexer. The output is either serial binary or parallel binary as desired.

Radiation, Inc., P. O. Box 37, Melbourne, Fla.



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The experienced Canadair team of nuclear physicists is available for consultation with scientists or industries to study and specify how nuclear knowledge can be applied in any field: generation of heat and power—medicine—agriculture—metallurgy or general industry.

Inquiries are particularly invited from universities, laboratories and industries. Write to Nuclear Division, Canadair Limited, Box 6087, Montreal.

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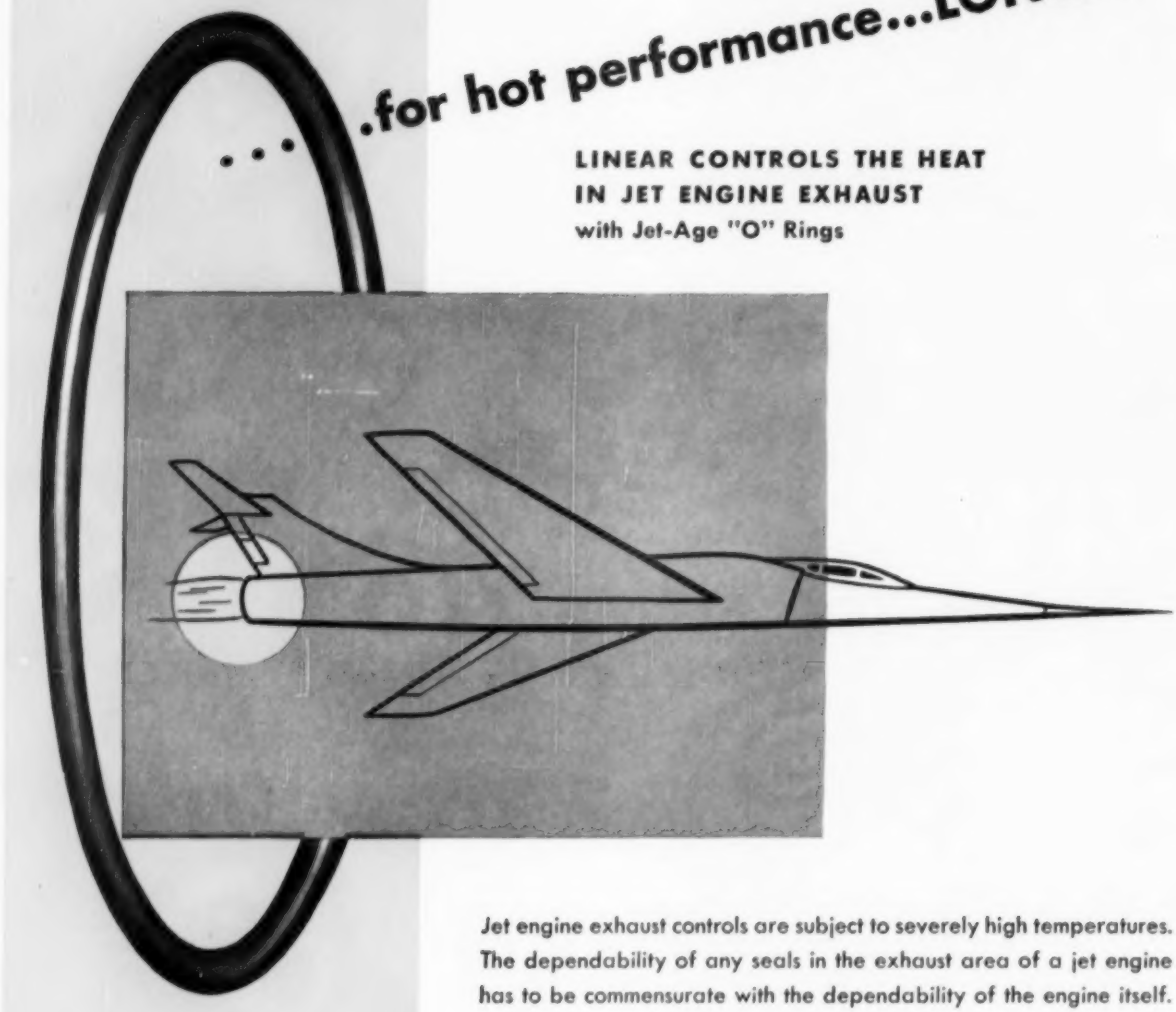
. . . for hot performance...LONGER

LINEAR CONTROLS THE HEAT IN JET ENGINE EXHAUST
with Jet-Age "O" Rings



Jet engine exhaust controls are subject to severely high temperatures. The dependability of any seals in the exhaust area of a jet engine has to be commensurate with the dependability of the engine itself.

LINEAR'S ability and extensive experience in the design and manufacture of precision "O" rings—in such modern, heat-resistant elastomers as the silicone family—makes this kind of dependability a reality. LINEAR "O" rings, capable of withstanding intermittent ambient temperatures as high as 1000° F—and the destructive actions of gases and fluids, help control the jet engine exhaust—for hot performance—longer.

For a sealing problem of any kind—call on LINEAR or one of its agents for engineering assistance . . .

and be sure to Specify LINEAR "O" Rings for every application.

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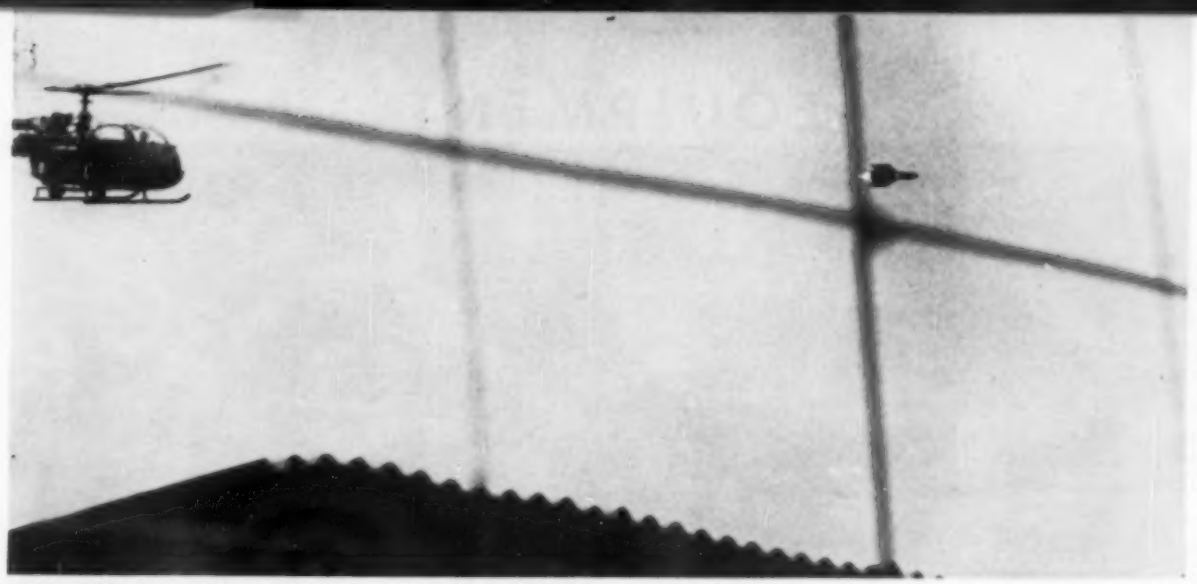
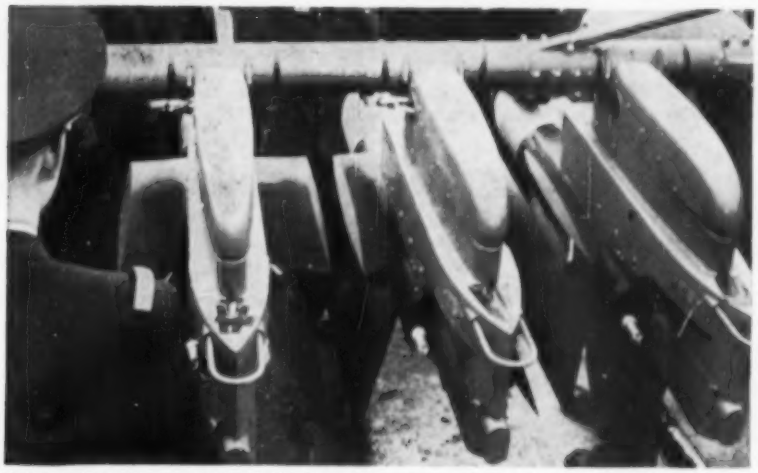


NORD SS.10 wire guided missile fired from Alouette is controlled by co-pilot. Israel used missile successfully against Egyptian tanks.

Alouette Fires SS.10 Missile



REAR VIEW of mounted missiles shows terminals where wire is attached.

RIGHT SIDE boom shows mounting details from front. Improved SS.11 is in production.

ARMED Alouette approaching in firing run carries three missiles on boom on each side of the helicopter.

FINAL CHECKING of LOX converters at Aro Equipment's plant. Each converter is filled with LOX and placed on a scale. After 24 hours an inspector checks weight to insure that the evaporation loss is within permissible limits.

Space, Weight Gain Boom Liquid Oxygen

By George L. Christian

Bryan, Ohio—Liquid oxygen is rapidly displacing aviation's old standby, gaseous oxygen, for a breathing supply in high flying jets. It and uses of other liquid gases are making cryogenics a necessary science in aviation.

An industry spokesman predicts that all future military aircraft having an oxygen requirement will be liquid oxygen equipped. Possible exception may be basic trainers. While the commercial jets currently being built will stick to gaseous oxygen systems for the time being, their conversion to liquid oxygen—LOX—is a possibility.

Space, Weight Saving

Principal reasons for the switchover to liquid oxygen is that LOX systems take one-eighth the space and weighs only one-third as much as gaseous oxygen systems of equivalent capacity.

Weight savings of LOX over gaseous oxygen systems are:

- **Typical bomber**—314 lb. Installed system weight for LOX is 120 lb., for gaseous system, 434 lb.
- **Typical fighter**—18 lb. Respective installed system weights are 10 lb. for LOX and 28 lb. for a gaseous system.

Moreover, substantial installation and maintenance economy and time saving derives from the fact that a 25 liter liquid oxygen converter system requires only seven manifold panel connections compared to over 200 connections for a comparable gaseous oxygen system.

Volumetric ratio of LOX to gaseous oxygen is approximately 1:860.

Liquid oxygen, along with other very cold liquid gases, such as liquid nitrogen and liquid helium, is also being pressed into new uses in missiles as well as in planes.

All three liquid gases can be used in missile auxiliary power systems to operate various controls, to pressurize certain portions of the weapon or act as coolants for excessively hot areas or components. Nitrogen, being inert, can also be used to purge expended fuel systems in either missiles or planes.

The rapidly expanding use of these extremely cold gases, LOX at −300F, liquid nitrogen at −320F, and liquid helium at −450F almost reaching absolute zero, or −459.6F., is sparking an expansion of cryogenics—heretofore little used in aviation.

Cryogenics is the study of very low temperature elements, their properties, effects and how to handle them. Liquid helium, for instance, is best kept in a container immersed in liquid nitrogen to help keep it chilled.

LOX has already gained a firm foothold in military jets, trainers, fighters and bombers.

This partial list of LOX-equipped Air Force and Navy aircraft, ranging from obsolescent models to some that are not yet flying, indicates the widespread use of liquid oxygen:

- **Fighters:** F- and RF-84F; F-100C, D and F; F-101A and B; F- and TF-102A; F-104A and B; F-105A and F-106A of the Century series; Navy's FJ-3 and -4; F11F-1; F8U-1; F4D and F5D.
- **Bombers:** B-47; B-52; B-57; B-58; B-66.

TT-1 trainer is also LOX-equipped.

Pressure Suits

A relatively new use of the gaseous oxygen produced by LOX converters is to inflate the pressure suits now being worn by an increasing number of military pilots. Reason is that, since the pilot is already connected to his oxygen system for breathing at high altitudes, it is a relatively simple matter to use the same oxygen source to supply pressure to his suit in case of bail-out instead of having to bring in some other source which is not already connected to the pilot.

While the USAF and Navy both started using LOX at about the same time several years ago, the Air Force implemented its liquid oxygen program

more rapidly than did the Navy, which was faced with the difficult problem of providing LOX ground supply equipment aboard aircraft carriers.

Commercial jet airliners being built in this country, the Boeing 707, Douglas DC-8 and Convair 880, currently staying with gaseous oxygen systems, may convert to LOX within five years, or possibly much sooner, to take advantage of the system's weight and space saving.

On the Boeing 707, for example, conversion from gaseous oxygen to LOX will involve a weight saving of 187 lb., yet the oxygen supply is increased by 2,180 liters, or about 15%.

Big boon to airframe manufacturers and airlines alike is the fact that gaseous and liquid oxygen systems are compatible. Switching from one to another involves little more than removing the 1,800 psi. gaseous oxygen bottles and their pressure reducers and replacing them with much lighter and smaller LOX converters, which will operate at a pressure of approximately 65-100 psi.

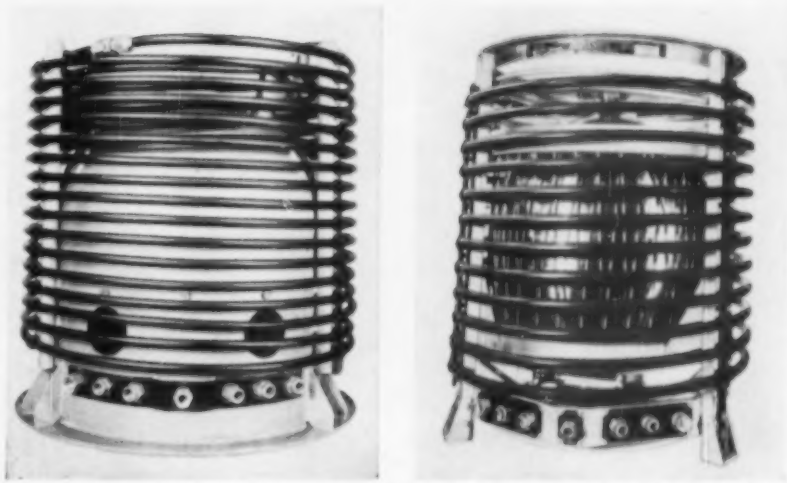
Sufficient length of line, or heat exchangers, will be provided between converter and pressure regulator to warm the very cold gas to near ambient temperature.

Transport Use

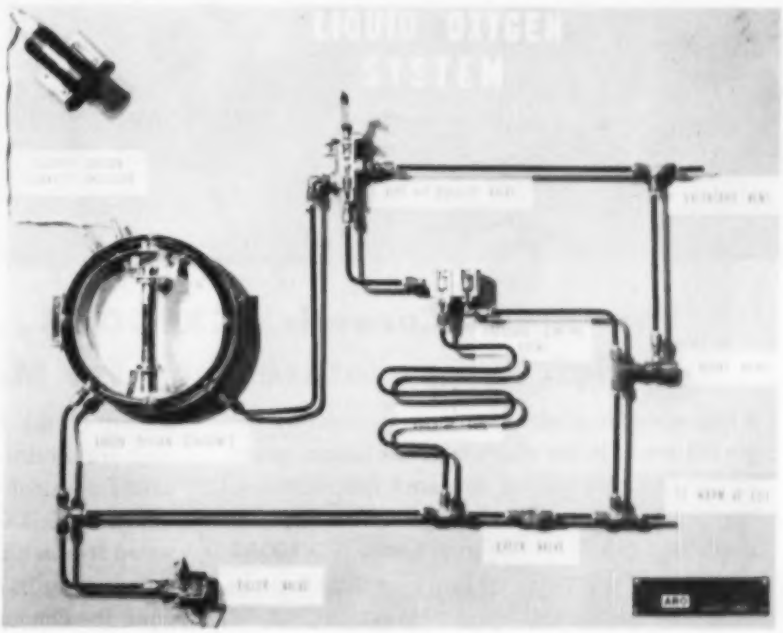
Oxygen systems on the future commercial jets will be used for two purposes: therapeutic reasons and to cope with such emergencies as explosive decompression. Several factors dictate that these systems remain gaseous for the time being. Among them are:

- **Ground servicing equipment** for LOX is non-existent at commercial airports, both here and abroad.
- **Regular topping off** to replace oxygen which inevitably boils off a LOX converter must be accomplished approximately every 48 hours since large size (20-25 liter) converters have an allowable heat loss of 8% of their volume by weight in 24 hours. In the case of a 25 liter unit, a total of five pounds of liquid is lost every 24 hours, or 10 lb. per 48 hours. Rigid handling techniques required when using LOX would mean a reindoctrination course for all personnel handling the material.
- **Airline maintenance** personnel are thoroughly trained on and familiar with servicing and maintaining gaseous oxygen systems.
- **Airframe manufacturers,** who have long and successful experience in designing and installing gaseous oxygen systems, are not anxious to go to the still relatively new LOX system in their new jets whose auxiliary systems they are striving to keep as simple and conventional as possible.

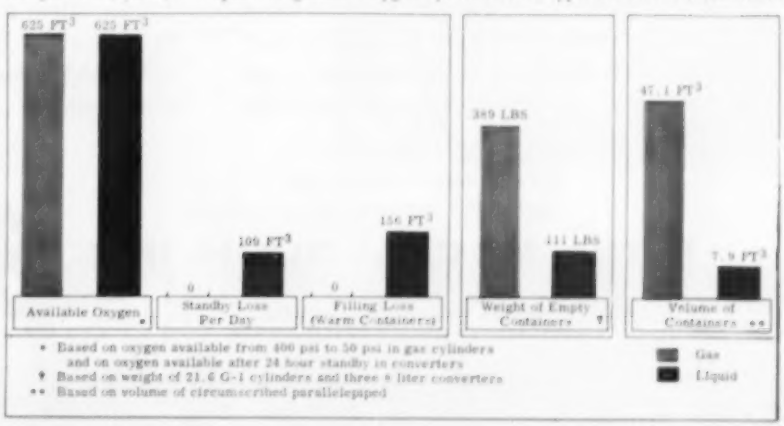
But, as more experience is gained



COMPARISON of 20 liter LOX converters: Aro unit at left; Bendix unit on the right. Note difference in shapes and that Bendix uses metal cables to reinforce its unit.



MODEL of a typical Aro LOX system economizer circuit. LOX vessel is at left. Bendix comparison (below) of liquid vs. gaseous oxygen systems for a typical bomber installation.


625 FT³
625 FT³
0
109 FT³
0
156 FT³
Available Oxygen*
Standby Loss Per Day
Filling Loss (Warm Containers)
389 LBS
111 LBS
Weight of Empty Containers †
47.1 FT³
7.9 FT³
Volume of Containers **
* Based on oxygen available from 400 psi to 50 psi in gas cylinders and on oxygen available after 24 hour standby in converters.
† Based on weight of 21.6 G-1 cylinders and three 6 liter converters
** Based on volume of circumscribed parallelepiped
Gas
Liquid

The EIMAC Ceramic 3CX100A5 . . . a High Temperature Tube for Modern Aircraft

A high speed high altitude aircraft leaves no margin for error. In the electronic installation, every component must be up to exact specifications. Heat is a problem. Altitude is a problem. Physical shock is a problem. The new Eimac 3CX100A5 meets exact specifications and maintains them in extreme environments.

The Eimac 3CX100A5 is a premium quality planar triode that replaces the older 2C39 series tubes. Its ceramic construction resists damage by thermal and physical abuse. It incorporates a new low noise grid. Long pulse cathode evaluation testing of the Eimac 3CX100A5 tubes assures electrical uniformity. Total indicated runout tests assure physical uniformity. It operates at full rating up to 60,000 feet. It sustains full output at elevated temperatures. It delivers 10 per cent more output than its predecessors through 2500 Mc. Thus, the Eimac 3CX100A5 overcomes every disadvantage of the old 2C39 type tube.

Discriminating avionic engineers can depend on the uniformity and performance of the Eimac 3CX100A5—whether in existing equipment or for future design.

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TYPICAL OPERATION 3CX100A5

	CW	AM		CW	AM
DC Plate Volts	800	600	DC Plate Amps.	.080	.075
DC Grid Volts	—20	—16	Power Output, Watts	27	18

through expanding military use of LOX, the switch-over on commercial jets is inevitable.

An AVIATION WEEK survey of airborne LOX equipment manufacturers show this current status of production:

• **Aro Equipment Corp.** here has supplied over 12,000 converters to the Air Force and Navy. Its LOX systems are installed on such planes as the F-102A, F-104A, F-105A, F8U-1, B-47 and B-52. Company has in production, or can make available LOX converters in sizes ranging from small 2½ liter units (which may be portable) to large 25 liter models (liter is .26 gal.).

• **Pioneer-Central division,** Bendix Aviation Corp., which estimates that it has about 50% of the market. Bendix converters are used in such aircraft as the B-58, F4D, A4D, F5D, F-100, B-47 and B-52. Bendix LOX converters range in size from 2½ through 25 liters.

• **Cambridge Corp.** is in production on a 10 liter converter for Lockheed's F-104B and on a 5 liter unit for an unspecified plane. Firm also has a 25 liter model available, although not in production. Features of the LOX converters, according to company officials, are reduced space envelope and weight. Cambridge, which is the only company engaged in the manufacture of both airborne and ground servicing equipment for LOX, says that it is preparing LOX ground handling equipment especially tailored to airline use which will be announced early in 1958.

• **Mine Safety Appliance Company** has, for the past year, been supplying 10 liter converters for Douglas' A3D. Company spokesmen say that they expect to expand the line soon to include converters of other sizes.

• **Linde Air Products Co.,** division of Union Carbide Corp., will start production this fall of a line of converters in the 10, 20 and 25 liter sizes. Company says that, by using an aluminum outer sphere (with a stainless steel inner sphere) it hopes to achieve a 10-25% weight advantage over competitive converters.

• **Carter Laboratories** says that it recently received a contract from Navy's BuAer to develop a new type of LOX converter made from titanium which will give a weight saving of approximately 50% over current production converters. The titanium units will also have high corrosion resistance, according to Carter. Other LOX converter makers believe that production problems associated with titanium will make the manufacture of titanium converters extremely difficult.

Aro, a medium-size company (gross annual sales of over $20-million, 1,700 employes) a few years ago was faced with the difficult problem of how to keep pace with competitive economic giants in the costly business of research and development.

In the aviation field, particularly in liquid oxygen system development, the headaches were particularly acute. Although Aro was prepared to tackle applied research and development, pure research presented many knotty problems.

The company was reluctant to expand its laboratories and hire the highly skilled specialists necessary to accomplish pure research in the many areas necessary.

So Aro decided on a program of assigning these abstract problems to qualified universities and research organizations which were equipped to handle research projects.

The system worked so well that the company quickly developed a coordinated and continuing program, still in full swing, tying its own research efforts to the colleges in such an effective manner that it is allowing Aro to compete successfully with its competition in both aviation and other fields.

Operation of the program is simple. Aro poses a problem to a university. The company pays all cost of the research and retains complete rights to the results. No one from Aro attempts

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b. ALL electrodes, in . . .
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How is this performance possible? THE MILLER GOLD STAR SR introduces a . . .
NEW transformer
plus
NEW weld stabilized current
plus
NEW completely sealed semi-metallic rectifier

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Tested across the country by practical, critical, hard-bitten working welders, here's what they say about the new Miller GOLD STAR SR:
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"here's DC welding current that's . . . perfect!"
"positively handles ALL electrodes better"
"best deal I've seen for v and o work"
"easiest arc starting in my experience"
"smoothest arc I ever used . . . and . . . quiet!"
"it's just plain the MOST"
Complete particulars on the MILLER GOLD STAR SR, including inert gas and automatic fixture welding, is now available on request.

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to interfere with or direct the research. When the abstract problem is licked, Aro's own development personnel take over the results for utilization.

Example of research farmed out projects:

• **Dynamic properties** of liquefied gases, oxygen in particular, which was handed to the University of Michigan. This new and basic research developed the first comprehensive information available on the behavior of liquid oxygen under pressure, at high altitude and in motion, according to Aro. Using data resulting from this program, Aro was able to alter the design of its LOX equipment materially to increase its efficiency. The study is continuing in order to supply Aro with further data for use on cryogenic products.

• **Welding methods** for vacuum vessels, which was assigned to Battelle Memorial Institute. Manufacture of LOX converters, for example, brought up several new production welding problems because of the extreme cold of the liquid oxygen it carried. Also, because a near perfect vacuum has to be maintained between inner and outer spheres, special welding techniques, usable on a production basis, had to be developed to avoid draw, permeability and stress corrosion. The institute, after thorough study, recommended the proper welding methods and types of equipment needed (Heliarc welding equipment is used). Aro followed the institute's suggestions and trained its welders in the new techniques Battelle outlined. As a result, Aro manufactures, on a production basis, thousands of converters to military specifications.

• **Vibration studies** were given to the University of Iowa.

The university was able to solve a serious problem of stopping poppet valves from chattering.

Aro technicians have devised several significant refinements in the art of building LOX converters which are, essentially, highly efficient thermos bottles rigged with the necessary valving, piping and other accessories to allow liquid oxygen to vaporize into gaseous oxygen and release it under the most efficient means and controlled pressure to a plane's oxygen system.

A process which Aro technicians say is unique to their converters is the incorporation of a barium getter in the space between the converter's inner and outer sphere to produce a vacuum that is as clean as possible.

Barium Fired

Aro engineers say that the barium, in the form of a fine wire, is fired, when in place between the spheres, at a temperature of 2,000F. by an induction coil.

This activates the barium which then starts the process of gettering or adsorbing any impurities which might be present in the vacuum. Impurities adsorbed include nitrogen, hydrogen, carbon dioxide and water. Aro engineers contend that barium is far superior to conventional desiccants normally used for this purpose because the barium adsorbs the impurities permanently whereas desiccants, which adsorb impurities at normal temperatures, release them again when heated. Although barium also has this property, its release temperature is much higher than the maximum operating temperature of the converter.

Corollary advantages of the barium getter, which operates for the life of the converter, are:

• **Lengthens the life** of the converter. Initially, converters were warranted for only 30 days. When barium getters were installed nine months ago, it became apparent that the warranty time could be increased. It was first extended to 90 days, and now it appears that a one year warranty is perfectly feasible. Aro officials believe that further warranty extensions are in the offing.

• **Recover up to 75%** of converters that have been damaged through various means—within certain limits.

Other converter refinements used by Aro include:

• **Special high temperature** outgassing (evacuation) technique which drops the atmospheric pressure of the vacuum to .001 microns of pressure in terms of millimeters of mercury. Delicacy of the outgassing procedure is indicated by the fact that a fingerprint on the surfaces of the vacuum chamber can double the outgassing time; therefore all workers concerned wear gloves.

• **Special pinch-off** tool is used to seal the vacuum chamber instantaneously to prevent any air from re-entering.

• **Special suspension system** is used to secure the inner sphere within the outer chamber securely yet keep the heat transfer from LOX container to outer shell to a minimum.

Special precautions are taken to inspect with X-ray all of the extra low carbon stainless steel stock used to

LOX Handling Precautions

National Safety Council recently issued these LOX (temperature: —300F) handling precautions which were drawn up by H. R. Carpenter, Safety Engineer, North American Aviation, Inc., Los Angeles division.

LOX, like gaseous oxygen, ignites readily when it comes in contact with combustibles as oil or fuel. LOX storage area should be away from combustibles and sources of ignition and should be clearly marked as a hazardous zone. At North American, the LOX storage area is completely surrounded by a fence and protected by a locked gate.

Only fire personnel have access to the area. They control deliveries and release portable servicing units. Extra fire equipment has been assigned to the area, and auxiliary firemen have been trained from among flight line personnel to work on the line.

The number of men handling LOX has been limited to those who complete an authorized operator's program. Only one man in each flight line crew is designated as a LOX operator. When it is necessary to fill an aircraft, the operator must contact the fireman on duty to check out a portable unit. Before another operator can use this same piece of equipment, the first man must check the unit back in. This insures that the equipment is used only by competent personnel.

Precautions to observe before filling an aircraft's LOX system include: plane must never be filled with LOX while it is being fueled. Plane must not be filled when the electrical system is energized or when hydraulic power is on. All spilled oil, fuel or hydraulic fluid under the aircraft must be cleaned away before filling with LOX.

Operator precautions include: Before filling an aircraft with LOX, he must don protective garments which are only supplied to authorized operators. These are a hood, asbestos gloves and a full-length smock. While the hazard of contact with a —300F fluid is obvious, the danger of a man's clothing becoming impregnated with LOX is not so well understood. Clothing which becomes impregnated with LOX can be ignited some time after the LOX contact by the flame of a match or lighter.

As double insurance against hose failure, the operator must remain at the filler controls during the entire operation so that flow can be shut off immediately should the hose fail. Also, this procedure prevents excessive overflow which can be hazardous. During topping off procedures, the operator must watch the fill level closely to stop flow as soon as the system is full.

Operator must wear his protective garments while filler hose is removed. All other personnel on the plane are warned to stay clear during hose removal.

Oxygen for Commercial Jets

Entire question of oxygen for commercial jets is clouded by lack of governmental regulations on the matter, by debate on liquid vs. gaseous system use, and by lack of unanimity among the airlines as to whether oxygen is necessary at all.

Some European airlines feel that oxygen is unnecessary because of the unprecedented integrity of fuselage and windows of the jets which are built with the same "it shall not fail" design philosophy which dictates wing structure. Most U.S. carriers feel that they should provide the added insurance of oxygen, at least at the outset.

The British have made no provisions for passenger oxygen on Comets except for those that had been ordered by Capital Airlines. U. S. pilots are opposed to the possibility that they might be required to wear an oxygen mask at all times during flight as Comet pilots were required to do.

A senior pilot of one airline buying jetliners told Aviation Week, "If such a regulation is put on the books it will be unenforceable unless a CAA inspector rides in the cockpit of every jet flying." His reasoning: if a cabin window blows out, the pilots will have time to put on their masks—which might be hung around their necks—and initiate emergency descent procedures. If a cockpit window blows, as he said, "chances are that you've lost an airplane. Even if the captain is strapped in and doesn't blow out of the broken window, he will be hit on the head by all the cockpit paraphernalia which will be sucked out by the violent blast caused by the large pressure differential between the 8,000 ft. cockpit altitude and the 40,000 ft. outside altitude . . . but the chances of this happening are as remote as having a wing break off."

Pilots who have flown the Boeing 707 stress the 15,000-ft./min. emergency rate of descent possible as a major safety feature to enable a descent to a low altitude quickly enough that danger of pilots losing consciousness because of lack of oxygen are remote. Additional safety feature is that the 707's cabin windows are so small it will take several seconds—possibly up to half a minute—for the large volume of air within the big cabin to escape through such a relatively small opening to equalize with outside pressure.

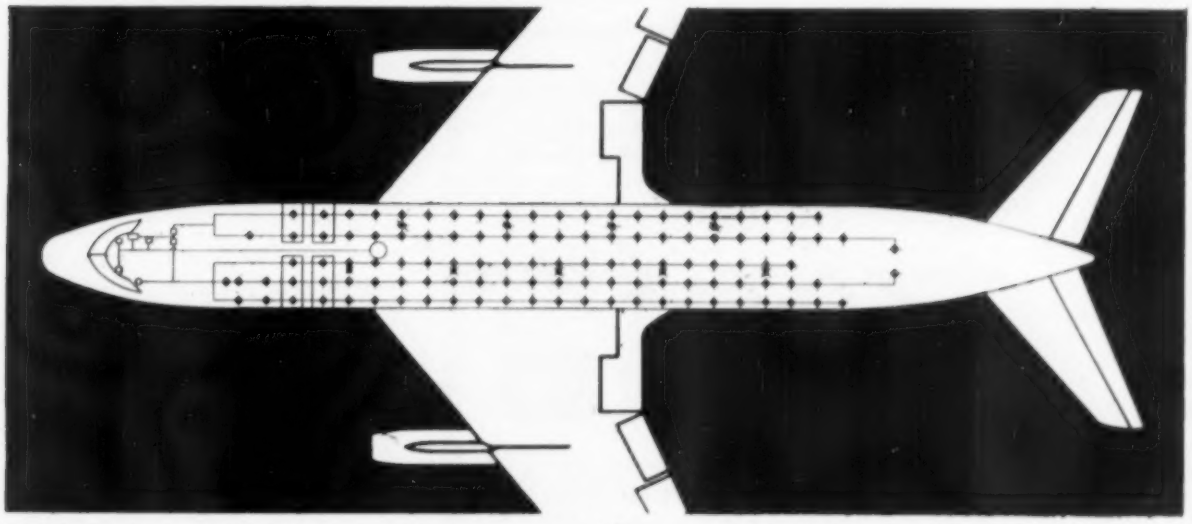
Boeing has no present plans to use liquid oxygen in the 707, but has made feasibility studies on the subject. Customer preference indicates no present plans to use LOX on DC-8s.

If a cabin window on the Boeing 707 does blow out over 14,000 ft. an automatic, aneroid-operated trigger assembly, made by Scott Aviation Corporation, releases oxygen pressure throughout the cabin oxygen system. Pressure of the oxygen almost instantaneously releases masks through trap doors located directly above each passenger seat. Extra masks will be provided for children. The masks are specially designed of sponge rubber to fit comfortably and snugly over the passenger's face. Being perfectly symmetrical, they do not require study to be put on and an unindoctrinated passenger should be able to position one on his face in a matter of seconds. Masks can also be manually released from the cockpit.

Whether passengers will have time to use their oxygen masks before they become unconscious because of lack of oxygen is debatable and depends on many factors. Among them: speed of mask application, rate of loss of cabin pressure, speed with which pilots are able to initiate emergency descent procedures, and the person's own physical stamina.

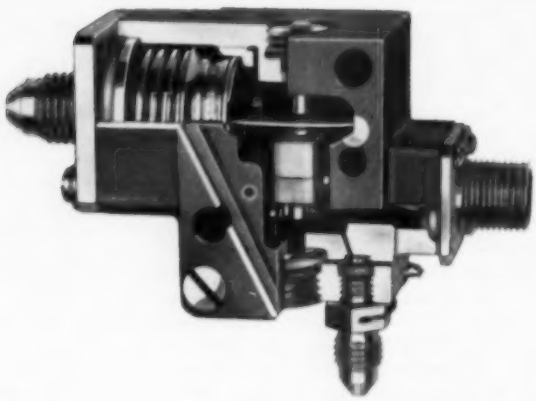
Whether airlines will follow the military's example of switching over to LOX is debated, according to an airline contacted by Aviation Week. That carrier said that it will definitely not go to LOX. Reason is the added cost and complication of buying and maintaining special ground LOX servicing equipment, the inherent danger in handling LOX, and the labor required by the necessity of continuously having to top off LOX converters to make up for boiled off oxygen overcomes the weight advantage of airborne liquid oxygen systems over the gaseous oxygen systems. Other carriers are taking a "let's wait and see" attitude.

Lack of unanimity among airlines about the use of LOX is indicated by these varied answers to an Aviation Week survey of air carriers. An official of one international airline said that it would never use LOX. The cost of spotting specialized ground equipment at many bases and the cost of maintaining and topping off LOX systems at regular intervals, coupled with the danger of handling liquid oxygen, overcomes the weight and space savings such systems would provide, he said. Vice president-engineering, of a large domestic carrier said with equal zeal that his company would certainly go to LOX—probably within 3-4 years—because of the weight and space saving advantages of the system.



SCHEMATIC shows a typical liquid oxygen system layout for any of the up-coming jet airliners proposed by Aro.
Indicates one additional mask per four rows of seats on right side for children.
Indicates quick release oxygen couplings at five positions for cabin attendents.

Announcing —



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Azusa, Calif.

*Pat. applied for. Switch shown here actual size.

manufacture the converter shells to assure zero permeability, lack of voids and to detect any other imperfections which might be present.

All seals used in the liquid phase of the converter are metal-to-metal with surfaces lapped to a very high finish.

Low temperature Teflon seals are used in the gaseous phase of the converter.

As an Aro spokesman said, "a converter is either perfect or its just a piece of scrap."

Economizer Circuit

A converter refinement, not exclusive with Aro, but used on all of its units is an economizer circuit which increases the effective oxygen capacity of the LOX system by 15-25%. Under extremely favorable circumstances, the circuit may almost double the oxygen supply.

Aro pays for a rather expensive test of its converters. One out of each 150 units built is sent to the Armour Research Foundation where is is subjected to vigorous vibration tests, then is fired at with a 50 caliber armor-piercing bullet.

This is done at Aro's expense. So far, over 80 converters have been subjected to this test.

With an eye to the future, Aro recently made a comprehensive proposal to Convair for a LOX system for its 880 jetliner. Total empty weight of the system, including six masks for cockpit crew and 119 masks in the cabin, is 273 lb.

Aro also has developed for Trans World Airlines estimated LOX system requirements for the carrier's up-coming Boeing 707s and Convair 880s.

Expansion Program

In the way of expansion, the company's Aircraft Division has already entered the first phase of a new five-year expansion program. A separate Bryan Ohio plant has been enlarged to twice its original size to serve as headquarters. All aircraft operations formerly conducted in other locations have been transferred to this plant. It is known as the Cryogenics Center to indicate that all Aro-made products whose operation is related to low-temperature liquefied gas are consolidated there.

Aro recently affiliated itself with a British company and formed British Oxygen-Aro Equipment Ltd., which is Aro's London subsidiary. The British firm had long experience in designing and manufacturing equipment destined to operate in very cold climates. Aro estimates that its affiliation with the British organization cut its own cryogenic research and development program time by 3-5 years.

The two companies are now defining the areas in which they shall work to avoid duplication of effort. In the mean time, the British firm is engaged in the distribution of Aro's aircraft products in Europe and will soon be equipped to manufacture them. Among other items, the British firm is just setting up to produce LOX converters for NATO.

From 1955 to 1956, Aro's gross profits went up from $5,437,000 to $5,844,000, earnings after taxes climbed from $1,107,000 to $1,193,000 and earnings per share moved from $2.05 to $2.18.

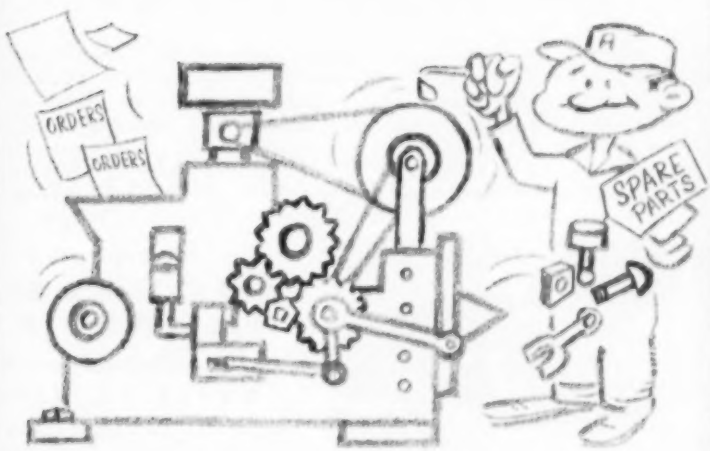
Employment increased from 1,430 to 1,700.

USAF Awards Contract For Generator Units

Contract amounting to $4.8 million for supplying generator sets to be used in support of Strategic Air Command B-52 bombers was awarded by the Air Force to Aircraft and Equipment Division of Consolidated Diesel Electric Corp., Stamford, Conn.

Units are self-propelled and consist of engine driven generator sets which produce a.c. and d.c. power for testing of the aircraft's electronic systems, including radar, navigation and fire control.

Parts With TECHNICAL HELP!...



Part numbers . . . model numbers . . . modifications . . . serial numbers . . . manufacturers . . . all spell trouble when you need spare parts in a hurry.

That's where Airwork helps. All the key men in Parts Supply have had at least 3 year's preliminary training in Airwork's own overhaul shops. Then, after they knew the parts by application and appearance . . . they were given the desk-type training needed to cut through the maze of technical information to the correct part number.

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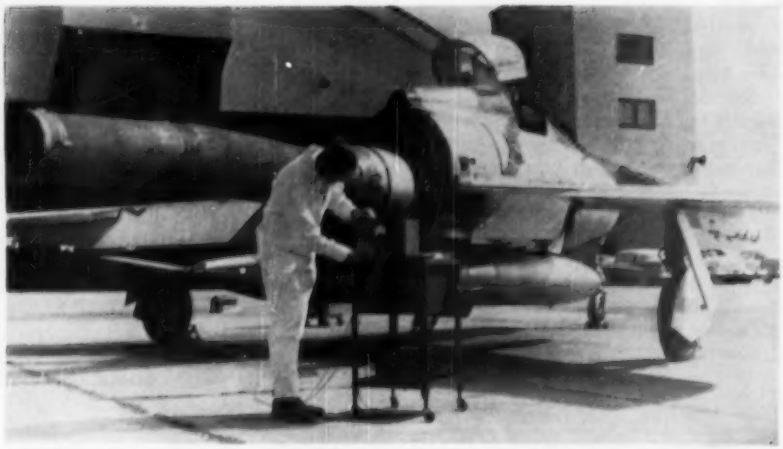

OPERATION of engine in Republic F-84F is checked by Sperry vibration monitor.

Engine Vibration Monitor System Developed for Jets, Turboprops

A new turbojet and turboprop engine vibration monitor developed by Sperry Gyroscope Company, measures vibrations created by the engine, propeller or both within selected cycle ranges.

Lightweight monitor is being negotiated for by airlines for installation in their up-coming jet and turboprop airliners. Also, the Air Force has scheduled preliminary tests for the equipment on jet aircraft while the Navy is planning similar checks, according to Sperry.

The monitor measures turbine shaft vibration in jet engines and both turbine and propeller shaft vibration in turboprop powerplants to warn the crew of impending troubles caused by unbalance of rotating parts within the engine or propeller.

Components of the system include:

• **Pick-up,** sensitive but rugged unit one or more of which can be mounted at strategic locations on the engine to pick up vibration if it occurs. Pick-ups have a temperature range of 500F to −65F.

• **Amplifier,** lightweight unit which receives signals from the pick-up through wires and translates them into signals which register on a cockpit meter or flash an alarm light.

• **Meter,** calibrated from 0-5 relative amplitude of engine vibration. Typical installation red-lines the instrument from 2½ to 5.

To assure versatility, the system's two-channel amplifier incorporates two high-pass filters which may be set to various frequencies.

On a typical system, Sperry has set one filter at 135 cps. to pick up only the high frequency vibrations associated with the high speed turbine in a twin spool engine, such as the Pratt & Whitney Aircraft J57, and its bearings. Vibration generated by the low speed rotor is excluded.

A second 45 cps. setting is used to measure vibration in the low speed tur-

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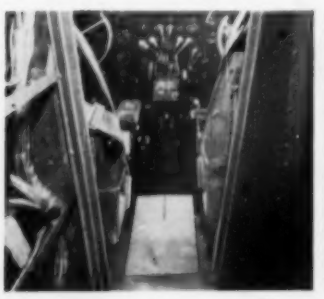
The Bendix X-Band Weather Radar System was chosen because the Bendix name stands for top quality equipment and top performance in all communications, weather radar and navigation systems. Whatever your needs are in the field of electronics, call on the craftsmen of Executive Aircraft. We take pride in saying that satisfied customers are our best recommendation. Why not find out for yourself?



View of Lodestar cockpit with Bendix X-Band Weather Radar up and in position for use and folded away in floor well of cockpit between the two pilot seats. Note also the Bendix radio equipment and the treatment accorded the overhead radio and electrical control panel.

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MAIN components of monitoring system are cockpit meter (left), amplifier module with two channels, and (hand-held) a miniature pick-up with —65F to 500F range. Weight: 13-34 lb., depending on use.

bine and pick up such incipient failures as cracked or bent rotor buckets.

An optional 15 cps. filter is available for use with turboprop installations to detect propeller vibration.

Weight of the system installed varies from 12 to 34 lb. depending on the plane, number of engines and number of pick-ups per engine.

Basic components of a typical four-engine system includes a short ½ ATR rack with four amplifiers modules, four indicators, one to four pick-ups per engine, a pick-up switch and optional warning lights. Total weight would be about 24 lb.

Auxiliary Pressure Systems Developed

Auxiliary mode of cabin pressurization control has been developed by AiResearch Manufacturing Division, the Garrett Corporation, for Convair's 880 jetliner.

While the normal pressurization controls operate pneumatically, the auxiliary system functions electrically and is set in motion by a cockpit switch in case the pneumatic system fails. Pneumatic and electrical pressurization controls are independent of each other and are so designed that electrical portion can override the pneumatic system.

Normal cabin pressurization system controls are two knobs, one to select cabin altitude (whose range extends —1,000 ft. to 10,000 ft. above sea level) and a rate of change used during climb and let-down.

In addition to the pressurization system, AiResearch will produce the main engine bleed system for the 880. Composed of 22 valves, this system controls the pressure of bleed air from the four jet engines, making this air available for the pressurization, deicing and rain clearing systems.

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Counsel for Hughes, CAB Spar Over His Appearance At Hearing

By Glenn Garrison

New York—Howard Hughes' presence at a Civil Aeronautics Board hearing into his possible control of Northeast Airlines through Atlas Corp. was forestalled by his counsel during the first phase that ended here recently. But Hughes is expected to appear for the second phase of the hearing.

At the hearing's outset, Abraham Mollet, Bureau of Air Operations counsel, tried to arrange a time for Hughes to testify. Hughes' counsel contended that testimony of other witnesses would make his appearance unnecessary. It was agreed that, if all points were cleared up by other testimony and exhibits, Hughes might be spared a session in the witness chair.

Questions Remain

Several questions remained, however, and Hughes will be called to testify at a time and place as yet unspecified. CAB can subpoena Hughes if need be.

Hughes showed no interest in controlling Northeast Airlines through acquisition of Atlas Co. stock, two Hughes aides did testify.

The hearing grew out of joint pleading by Eastern Air Lines and National Airlines in the New York-Florida case which raised the question of possible Hughes control of Northeast in addition to Trans World Airlines. Such a situation, without Board approval, would violate Section 408 of the Civil Aeronautics Act.

Counsel for Hughes described the procedure as "harassment" of him for an "accidental event." Hughes owns 961,616 shares of Atlas common stock, which at the time of the merger was about 11% of the total and made him the largest single stockholder. His shares now represent about 9% of the Atlas total. Atlas holds a majority interest in Northeast Airlines.

Floyd Odlum, president of Atlas, owns 117,156 shares of Atlas voting stock, or about 1.2%. Odlum, however, claims control of ownership of 1,284,720 shares, or 13.6%, plus additional control through option warrants which brings the claim to more than 35%.

Basis for the RKO-Atlas merger was arrived at in 1954-55, according to T. A. Slack, Hughes Tool Co. vice president and attorney for Hughes and a director of TWA. Slack testified that he carried on negotiations with Odlum for Hughes, and was not aware of Hughes' "giving any weight" to the Northeast Airlines interests held by Atlas.

Odlum Plan

Odlum tried to sell the Hughes side on accepting preferred instead of common stock, Slack said, and "advanced every reason in the world he could think of." One reason was possible embarrassment with CAB in ownership of common—i.e., voting-stock in a corporation which controlled Northeast.

Slack was convinced such common stock ownership was no cause for concern, he testified, and furthermore the deal "certainly wasn't a secret from CAB."

Noah Dietrich, TWA director, former Hughes Tool Co. official and one-time RKO board chairman, testified that Odlum also had discussed the merger with him and had urged him to recommend that Hughes accept the preferred stock. Dietrich said he advised Hughes to insist on the common stock, however, acting on a "general theoretical basis" in the belief that it offered more appreciation potential.

Hughes decided in favor of common stock, Dietrich testified, probably

Send-Off for Cargo Service

Start of DC-6A cargo service by United Airlines at Boston was preceded by an unusual breakfast which the airline gave aboard one of the airplanes. Guests included city and postal officials, traffic managers and shippers.

because its speculative possibilities were greater.

Hughes "indicated to me very clearly," Dietrich testified, "that he didn't plan to take any voting interest in Atlas."

Slack also said that Hughes had passed up an opportunity to name someone to the board of directors of the newly merged company.

Odlum testified at the hearing that Hughes declined representation on the Atlas board.

Odlum also claims a commitment of Hughes' proxy in voting Atlas stock. Northeast Airlines, in responding to Eastern's and National's charges in the New York-Florida case, reported that Hughes "has committed himself irrevocably to the president of Atlas to permit the latter to vote Hughes' stock in Atlas until such time as Hughes may dispose of the stock."

Proxy Agreement

According to Dietrich and Slack, however, no mention of such a proxy agreement was made to them by Hughes.

Elaboration of this point undoubtedly will be asked of Hughes when he testifies.

At the outset of the hearing, Moller discussed a suggestion that the matter be disposed of by setting up a voting trust for Hughes stock in Atlas, under which trustees acceptable to CAB would vote the stock for five years. By the end of that time, the stock would be sold by Hughes.

Counsel for Hughes, Moller said, had rejected the suggestion and had repeated an offer of notice by Hughes before he voted any of stock. This offer, the bureau counsel said, had been rejected by the Bureau of Air Operations.

Hughes' counsel retorted that while Hughes had no desire to control Northeast, his investment in Atlas totals $8-9 million and it seemed unreasonable from a business standpoint to require him to sell within a specified time.

Voting Trust

An alternate suggestion that the voting trust be established for a 20-year period and that there be no selling provision was received favorably by both counsels and will be studied further.

Hughes' counsel called the whole matter "a rather absurd affair" from Hughes' point of view and asked that any agreement be worded to protect Hughes against "any public accusation."

The hearing before Examiner Paul N. Pfeiffer was observed by James Anton, chief of CAB's office of compliance. If the Board finds that the Hughes Atlas holdings involve a violation of Section 408, the Board itself can specify remedial action such as divestiture.

Redstone Displayed in Grand Central

Army's Redstone ballistic missile is displayed in New York's Grand Central station. The 62 ft. missile was largest object ever exhibited there.

Navy Contracts

Following is a list of unclassified contracts for $25,000 and over as released by Navy Contracting Offices:

AVIATION SUPPLY OFFICE, 700 Robbins Ave., Philadelphia 11, Pa.

Polytechnic Research & Development Co., 202 Tillary St., Brooklyn 1, N. Y., radar test sets (383/29069-127 E 2/6/57, 383/9504-66/57), $243,643.

Regent Jack Mfg. Co., Inc., 11965 Regentview Ave., Downey, Calif., hydraulic aircraft jacks (IFB 383-1594-57), 217 ea., $106,113.

Pioneer-Central Div., Bendix Aviation Corp., 2600-2800 Hickory Grove Rd., Davenport, Iowa, indicators (PREN 11-1288/57) various, $134,499.

United Steel & Wire Co., 27 Fonda St., Battle Creek, Mich., platforms (383/29065-5783/5/6/57 Aero) (383/29065-5583/5/6/57/Aero) (383/9504—73/57), $153,969.

Firestone Tire & Rubber Co., 1200 Firestone Parkway, Akron 17, Ohio, life preservers (218/7003/57) 8,000 ea., $172,400.

Scintilla Div., Bendix Aviation Corp., Sherman Ave., Sidney, N. Y., tube assys. (383/2118-183/55Aero) 1,901 ea., $61,079.

Sperry Gyroscope Co., Div. of Sperry Rand Corp., Great Neck, N. Y., testers and publications (383/27164-9183/357/Aero) various, $548,343.

BUREAU OF AERONAUTICS, Wash. 25.

Garrett Corp., (AiResearch Mfg. Co. of Arizona Div.) Sky Harbor Airport, Phoenix, Ariz., air turbine starters, NOas 57-587-f(PD-43-1216-57) $79,499.

Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn., propellers NOas 57-323-r(PD-41-1075-57) $2,961,675.

Chicago Aerial Industries, Inc., 1980 Hawthorne Ave., Melrose Park, Ill., conversion study and a prototype camera, NOas 57-677-f(PH-4-2534-57) $80,000.

McDonnell Aircraft Corp., St. Louis 3, Mo., modernization programs for F3H type aircraft, NOas 57-805-c(PD-22-499-57) $7,918,460.

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U. S. ARMY SIGNAL SUPPLY AGENCY, 225 S. Eighteenth St., Philadelphia 3, Pa.

Aircraft Armaments, Inc., Cockeysville, Md., countermeasures transmitting set AN/TLT-1, 1 ea., modification, contract no. 73026, (PR&C 57-ELE/D-1405), $36,341.

Keysam Corp. of America, Paterson, N. J., additional services, facilities and materials for 6 months to complete investigation of the physical characteristics of balloons and balloon materials, modification, contract no. 72386 (PR&C 57-ELE/R-2113), $54,400.

Sylvania Electric Products, Inc., N. Y., N. Y., VHF countermeasures sets, fabricated and installed in ¼ ton 4x4 trucks 4 ea., modification. Contract No. 73194 (PR&C 57-EIH/D-6001) $62,644.

LOS ANGELES ORDNANCE DISTRICT, 55 S. Orange Ave., Pasadena, Calif.

Douglas Aircraft Co., Inc., 3000 Ocean Park Blvd., Santa Monica, Calif., spare parts for the Nike system (catalog contract) 4 Jobs—$457,626.

United Electrodynamics, Div. of United Geophysical Corp., 1200 S. Marengo St., Pasadena, Calif., data reduction equipment for reducing service evaluation telemetry recording for Corporal program. Job—$210,-701.

WHITE SANDS PROVING GROUND, N. Mex.

DD-Delta Steel Buildings Co., P. O. Box 10193, Dallas, Tex., surveillance radar facilities, White Sands Proving Ground, N. Mex. DA-29-040-ORD-1173. Job—$50,604.

REDSTONE ARSENAL, Huntsville, Ala.

Thiokol Chemical Corp., Trenton, N. J., research and development in support of Falcon missile program, $32,051.

Thiokol Chemical Corp., Trenton, N. J., continue development of XM10 rocket engines, $154,535.

Thiokol Chemical Corp., Trenton, N. J., development of XM12E1 type rocket engines, $892,837.

CORPS OF ENGINEERS, Detroit District, 600 E. Jefferson Ave., Detroit 26, Mich.

Champion, Inc., P.O. Box 231, Iron Mountain, Mich., construction of gap filler facility, including all related work necessary and appurtenant thereto, in the vicinity of Norway Dickinson County, Mich. (IFB ENG-20-064-57-42) $47,129 (est).

C. A. Lehman & Sons, Inc., 2615 Oliver St., Fort Wayne, Ind., construction of rocket storage bldg., including all related work necessary and appurtenant thereto, Baer Field, Fort Wayne, Ind., (IFB ENG-20-064-57-44) $72, 585 (est).

U. S. ARMY ORD. DIST., Los Angeles, 55 S. Grand Ave., Pasadena, Calif.

Firestone Tire & Rubber Co., 2525 Firestone Blvd., Los Angeles 54, Calif., concurrent repair parts for Corporal missile, $234,048.

PHILADELPHIA ORDNANCE DISTRICT, 128 N. Broad St., Phil., Pa.

Western Electric Co., Burlington, N. C. (DA-36-034-ORD-2228) Nike spare parts & components, $155,755.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts, for $25,000 and over, as released by the Air Materiel Command:

Northrop Aircraft Inc., Hawthorne, Calif., $2,817,995 for additional work and incorporation of contract change notices.

Collins Radio Co., Cedar Rapids, Iowa, $2,110,835 for radio receiver and dynamotor.

Crosley Division, Avco Manufacturing

Corp., Cincinnati, $6,242,875 for radar sets, AN-MPS-16.

Ward LaFrance Truck Corp., Elmira Heights, N. Y., $3,670,465 for aircraft towing tractor.

Sikorsky Aircraft Division, United Aircraft Corp., Stratford, Conn., $16 million for H-37A helicopters, equipment and data.

Jayval Co. of New Mexico, Las Vegas, N. Mex., $2,193,481 for parachutes.

Boeing Airplane Co., Wichita, Kan., $1,-759,973 for contract changes for B-52 aircraft.

Bell Helicopter Corp., Ft. Worth, $1,-679,160 for H-13 helicopters.

Wade-Lahan Construction Co., Colorado Springs, Colo., $1,667,211 for construction of non-portable water system.

Stromberg Carlson Division, General Dynamics Corp., Rochester, N. Y., $1,259,399 for components of AN-APN-69 radio beacon and spare parts.

Crosley Division, Avco Manufacturing Corp., Cincinnati, $6,632,000 for air traffic control centers, AN-GSN-XD-2.

Lycoming Division, Avco Manufacturing Corp., Stratford, Conn., $4,267,966 for development of YT-53 turboprop engine.

Radioplane Co., Van Nuys, Calif., $1,-103,374 for XQ-4A drone system.

Wright Aero Division, Curtiss-Wright Corp., Woodridge, N. J., $1,094,000 for overhaul and modification of J65 engines.

Kollsman Instrument Corp., Elmhurst, N. J., $2,651,127 for display panel and computer.

Erco Division, ACF Industries Inc., Riverdale, Md., $2,087,036 for bomb trailers, MF-10, and bomb cradles.

Royal Jet Inc., Alhambra, Calif., $2,-056,616 for tank assemblies.

O. A. Sutton Corp., Wichita, Kan., $2,-046,073 for jettisonable fuel tanks and data.

International Business Machines Corp., Poughkeepsie, N. Y., $2 million for production of combat direction controls.

Cardox Corp., Chicago, $1,255,067 for aircraft fire fighting and rescue truck.

Aircraft Engineering & Maintenance Co., Oakland, Calif., $1,125,666 for rehabilitation of F-80G aircraft.

Marmon-Herrington Co., Inc., Indianapolis, $1,045,797 for aircraft fire fighting trucks.

Southeastern Storage & Processing, Inc., Laurenburg, N. C., $1,104,975 for vehicle storage.

Stock Transactions

Washington – Acquisition and disposal of 105,000 common shares of Continental Air Lines, Inc. stock by Lehman Bros., their entire holding, has been reported by the Securities and Exchange Commission. The transaction was made through Frederick L. Ehrman, director, who disclaims admission of beneficial ownership. Ehrmans' direct holding is 1,000 common shares.

Marco F. Hellman, director, acquired 5,500 common shares for a total holding of 10,500 shares. A trust held by Hellman holds 700 shares. Other transactions reported by SEC include:

Aeroquip Corp. Disposal of 100 common shares by Frederic W. Corwin, officer, leaving a holding of 10,678; disposal of 200 common shares by Charles Hollerith, officer and director, leaving a holding of 16,412.

Air Reduction Co. Inc. Acquisition of 2,125 common shares through exercise of option and disposal of 1,500 common shares by George E. Hawkins, officer and director, for a total holding of 5,275; acquisition of 2,500 common shares through exercise of option and disposal of 1,500 common shares by John A. Hill, officer and director, for a total holding of 7,345; acquisition of 1,500 and disposal of 1,000 common shares by J. H. Himberstone, officer, for a holding of 2,987; acquisition of 1,000 common shares through exercise of option and disposal of 500 common shares by George V. Slottman, officer, for a total holding of 3,010 with 192 common shares held in a joint tenancy; acquisition of 800 common shares through exercise of option and disposal of 800 common shares by August J. Thoma, officer, for a holding of 2,487.

Air-Way Industries Inc. Acquisition of 300 common shares by Edward Lamb, officer, for a holding of 41,266 and acquisition of 11 common shares by Edward Lamb Enterprises, proportionate beneficial owner, for a holding of 57,202; acquisition of 100 common shares by Edward Lamb Enterprises, a beneficial owner, for a holding of 391,148 with the Unity Corp., a proportionate beneficial owner, holding 685; acquisition of 1,288 common shares by holding companies, proportionate beneficial owners, under Prudence H. Lamb, beneficial owner, for a holding of 117,546 with Mrs. Lamb beneficially holding 50,463 common shares.

American Bosch Arma. Disposal of 3,500 common shares by Allen & Co., beneficial owner under Charles Allen, Jr., director, leaving a holding of 70,214; disposal of 250 common shares by Frank I. Bertsch, officer, leaving a holding of 800; disposal of 1,500 common shares by Clifton T. Foss, officer, leaving a holding of 600; acquisition of 200 common shares by Harold R. Sennstrom, officer, for a holding of 305; disposal of 100 common shares by a beneficial holding company under William S. Wasserman, director, leaving a holding of 14,000 with Wasserman directly holding 12 shares and 4,969 shares in trusts.

Atlas Corp. Disposal of 2,000 option warrants by James Allen, officer, his entire holding with Mrs. Allen, a beneficial owner, holding 800 shares.

Avco Manufacturing Corp. Acquisition of 10,000 common shares by Arthur R. Kantrowitz, officer and director, for a holding of 11,000.

Bendix Aviation Corp. Disposal of 700 common shares by W. H. Houghton, officer

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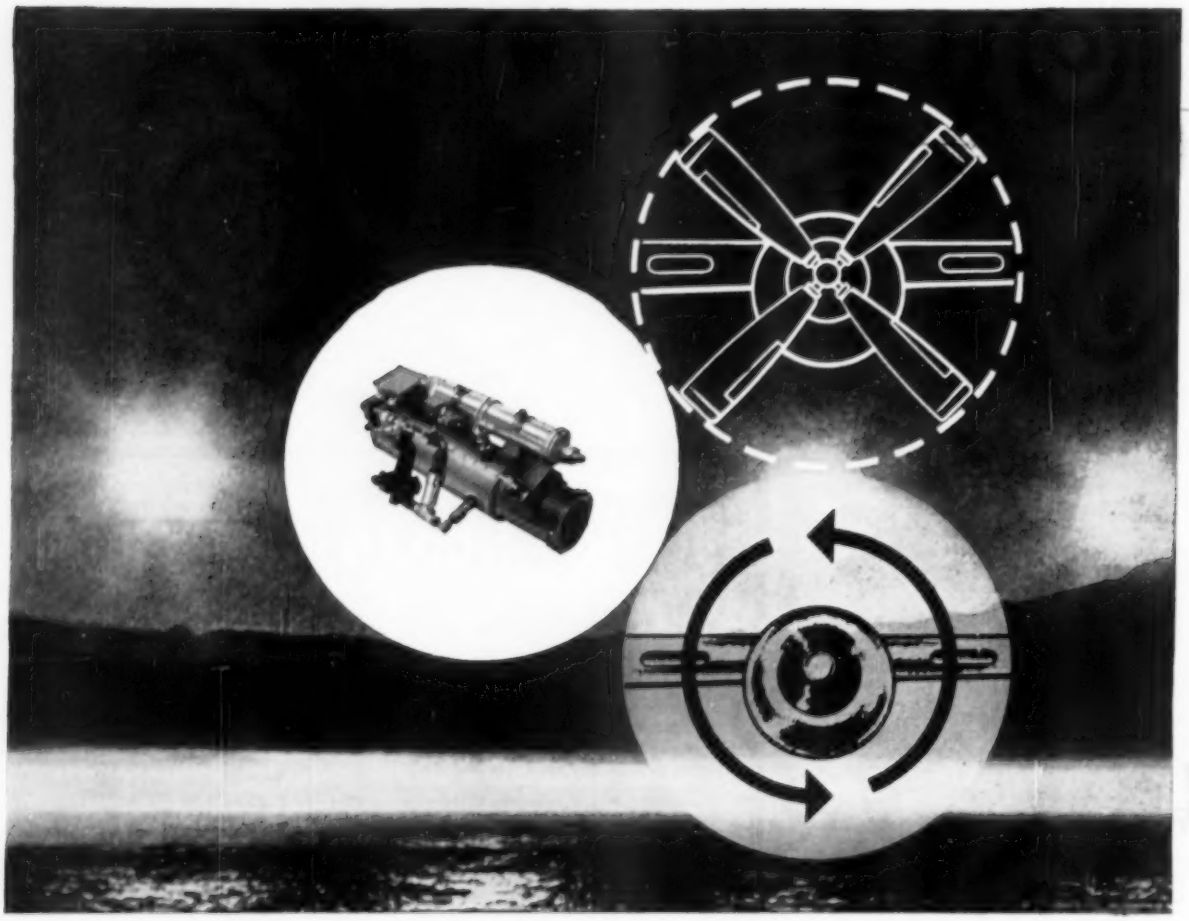

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and director, leaving a holding of 2,383; acquisition of 750 common shares through exercise of option by Raymond P. Lansing, officer and director, for a holding of 4,198; acquisition of 2,247 common shares through exercise of option by Palmer Nichols, officer, for a holding of 3,484.

Braniff Airways Inc. Acquisition of 4,020 common shares by George A. Butler, director, for a holding of 10,720; acquisition of 500 common shares and 420 common shares through exercise of rights by Roger J. Whiteford, director, for a holding of 1,120.

California Eastern Aviation. Disposal of 114 common shares by W. W. Brinkerhoff, officer and director, leaving a holding of 79,899; disposal of 1,000 common shares by Glenn A. Cramer, officer, leaving a holding of 594.

Capital Airlines Inc. Disposal of 500 common shares by Crawford Johnson Jr., officer, leaving a holding of 1,265; disposal of 1,600 common shares by Raymond G. Lochiel, officer, leaving a holding of 4,000.

Chance Vought Aircraft. Disposal of 200 common shares by H. B. Sallada, officer and director, leaving a holding of 1,000.

Curtiss-Wright Corp. Acquisition of 1,800 common shares through exercise of option by James G. Byron, officer, for a holding of 7,500; acquisition of 2,000 common shares through exercise of option and disposal of 900 common shares by S. B. Kruzina, officer, for a holding of 5,100; acquisition of 2,400 common shares through exercise of option and disposal of 200 common shares by William T. Lake, officer, for a holding of 2,800 with a trust under Lake disposing of 400 common shares, the entire holding; acquisition of 4,000 common shares through exercise of option and disposal of 2,000 common shares by Joseph V. Miccio, officer, for a holding of 5,500.

Delta Air Lines Inc. Acquisition of 1,423 common shares and disposal of 2,168 common shares by a partnership under R. W. Courts, director, for a holding of 2,250.

Douglas Aircraft Co. Inc. Disposal of 100 capital shares by Leo A. Carter, officer, leaving a holding of 2,000.

Eastern Air Lines Inc. Acquisition of 1,900 common shares by L. S. Rockefeller, director, for a holding of 93,700 with a trust under Rockefeller holding 3,542 shares.

Emery Air Freight Corp. Acquisition of 962 common shares by Peter J. Byrne, officer, for a holding of 3,672.

Fairbanks Morse & Co. Disposal of 700 common shares by William S. Covington, director, leaving a holding of 1,300 with Mrs. Covington disposing of 1,700 common shares as a beneficial owner, leaving a holding of 6,420, and the trusts for the Covington children disposing of 4,100 common shares as beneficial owners, leaving a holding of 940 shares; disposal of 200 common shares by Orren S. Leslie, officer, leaving a holding of 50; acquisition of 19,500 common shares and 12,500 common shares not in the open market by Penn-Texas Corp., a beneficial owner, for a holding of 666,550.

Fairchild Camera & Instrument Corp. Acquisition of 100 common shares by Mrs. Edgar S. Hill, beneficial owner, under Edgar S. Hill, officer, her total holding.

Fairchild Engine & Airplane Corp. Acquisition of 200 common shares by Richard S. Boutelle, officer and director, for a holding of 1,513; acquisition of 1,000 common shares by A. F. Flood, officer and director, beneficially as a trustee for a beneficial holding of 1,525 and a direct holding of 683; acquisition of 500 common shares by William Preston Lane Jr., director, for a holding of 2,100 with Mrs. Lane beneficially holding 600 shares and Lane jointly with Mrs. Lane holding 500 shares; disposal of 1,000 common shares by Grover Loening, director, leaving a holding of 9,500.

Flying Tiger Lines Inc. Acquisition of 400 common shares by William E. Bartling, officer, for a holding of 505; acquisition of $5,000 in convertible debentures by John C. Cosgrove, director, for a holding of $15,000.

General Dynamics Corp. Acquisition of 7,500 common shares by Robert C. Tait, officer, for a holding of 23,925.

General Electric Co. Disposal of 330 common shares by William R. Herod, officer, leaving a holding of 8,176; disposal of 475 common shares by Willard H. Sahloff, offi-

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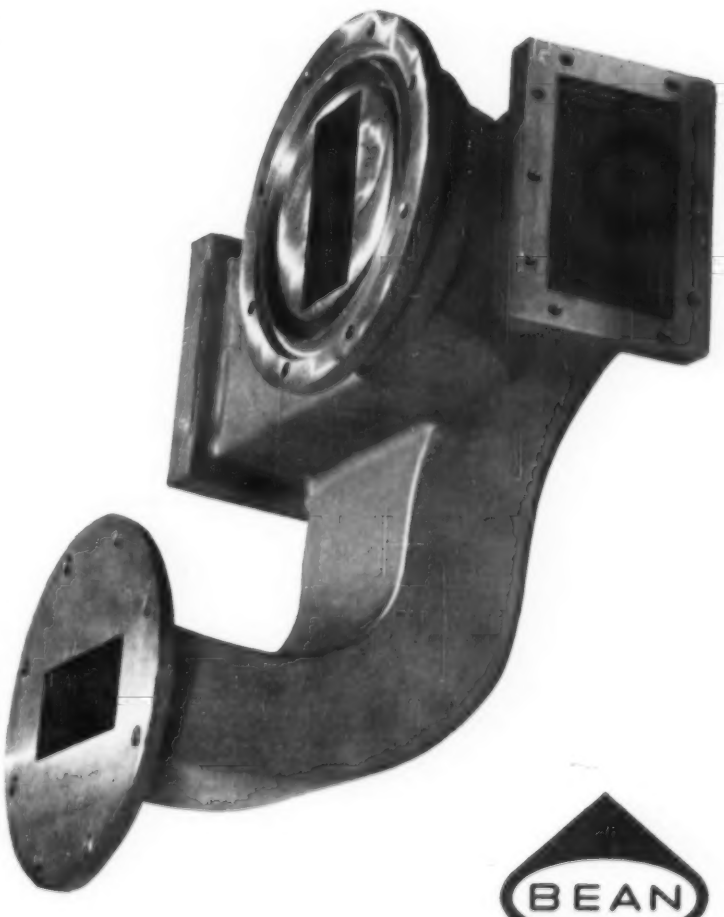

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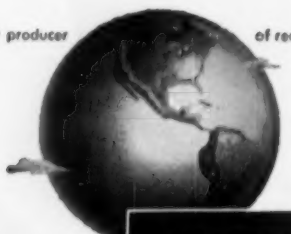

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cer, leaving a holding of 3,080.

W. R. Grace & Co. Acquisition of 1,000 common shares by Laurence H. Odell, officer and director, for a holding of 4,110; disposal of 2,450 common shares by Andrew B. Shea, officer and director, leaving a holding of 5,011; disposal of 150 Class A preferred shares by Michael G. Phipps, director, his entire holding, with holding companies beneficially owning 9,866 shares of which Phipps disclaims admission of beneficial ownership.

Irving Air Chute Co. Disposal of 3,600 common shares by Joseph Crowden, director, his entire holding.

Lear Inc. Acquisition of 304 common shares as a bonus by Roy J. Benecchi, officer, for a holding of 1,410; acquisition of 297 common shares as compensation by Norman Warren, officer, for a holding of 522.

National Aviation Corp. Disposal of 210 common shares by Frederick F. Robinson, officer, leaving a holding of 300; disposal of 1,200 common shares by Elmer Wellin, director, leaving a holding of 3,300.

Northrop Aircraft Inc. Acquisition of 258 common shares by William C. Duffie, director, for a holding of 1,000; disposal of 1,780 common shares by Edgar Schmued, officer, leaving a holding of 1,320.

Northwest Airlines. Acquisition of 500 common shares by A. J. Weatherhead Jr., director, for a holding of 3,150.

Pan American World Airways Inc. Acquisition of 500 common shares by Edward O. McDonnell, director, for a holding of 1,000; acquisition of 1,500 common shares by Vernon F. Taylor, director, for a holding of 3,500.

Piasecki Aircraft Corp. Disposal of 400 common shares by Elliot Daland, director, leaving a holding of 43,268; disposal of 500 common shares by Rudolph H. Deetjen, director, leaving a holding of 500; disposal of 700 common shares by Donald N. Meyers, officer, director and beneficial owner, leaving a holding of 43,267.

Raytheon Manufacturing Co. Acquisition of 1,000 common shares through exercise of option by D. R. Hull, officer, for a holding of 1,500.

Ryan Aeronautical Co. Disposal of 300 common shares by Mrs. T. Claude Ryan, a beneficial owner under T. Claude Ryan, officer, director and beneficial owner leaving a holding of 1,100, with Ryan directly holding 49,500 common shares and Emtor, Inc., a beneficial owner under T. Claude Ryan, holding 90,300 common shares.

Seaboard & Western Airlines Inc. Disposal of 600 common shares by Arthur V. Norden, officer and director, leaving a holding of 60,615; disposal of 3,200 common shares by Raymond A. Norden, officer and director, leaving a holding of 58,363.

Skiatron Electronics & Television Corp. Disposal of 600 common shares by Kurt Widder, director, leaving a holding of 8,900.

Slick Airways Inc. Disposal of 100 common shares by Charles F. Urschel, Jr., director, leaving a holding of 8,501.

Solar Aircraft Co. Acquisition of 100 and disposal of 4,500 common shares by Alexander Black, officer and director, for a holding of 55.

Sperry Rand Corp. Disposal of 3,000 common shares by Harry Landsiedel, officer, through joint ownership for a holding of 26,960 with Landsiedel directly holding 13,904 common shares; disposal of 5,000 common shares by Bernard O. Reuther, officer, leaving a holding of 25,000.

Trans Caribbean Airways. Disposal of 6,555 Class A common shares by O. Roy Chalk, officer, director and beneficial owner, leaving a holding of 31,331.

United Air Lines Inc. Acquisition of 100 common shares by Martin C. Ansorge, director, for a holding of 724; disposal of 200 common shares by Rexford E. Bruno, officer, leaving a holding of 389.

United Aircraft Products. Acquisition of 2,000 common shares by Emmanuel M. Cohan, director, for a direct holding of 2,500 with the Croydon Syndicate, a beneficial owner of which Cohan disclaims admission that he is a beneficial owner holding 3,000.

Western Air Lines Inc. Acquisition of $50,000 in convertible sub-debentures by Dudley Swim, director, for a holding of $316,000.

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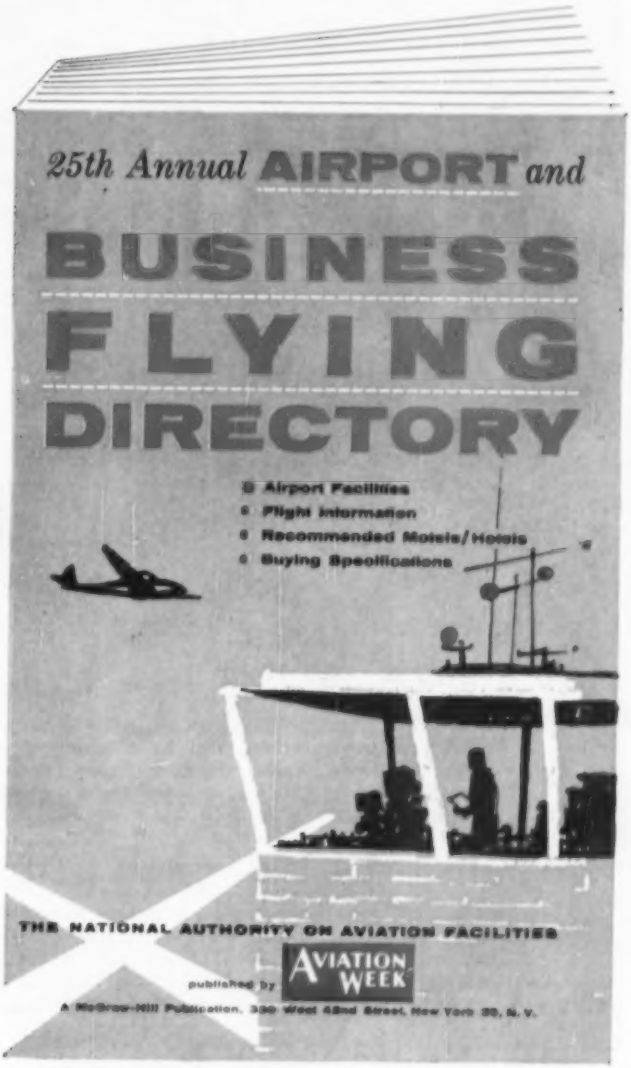

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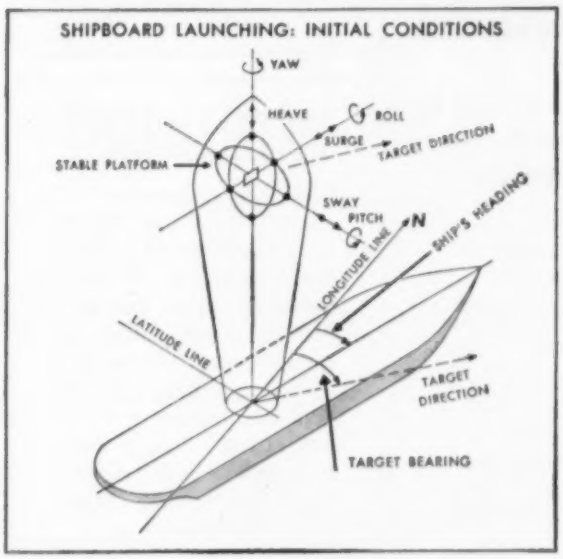

The diagram above presents the primary parameters involved in shipboard launching of a ballistic missile in its simplest form.

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In addition, the Polaris guidance and fire control systems must also operate effectively under the difficult conditions created by submarine launching.

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As prime contractor for IRBM and ICBM Nose Cone Development, MOSD can draw on a reservoir of top level experience and skill. This G-E department also has a backlog of significant experience in the development and manufacture of Naval Fire Control Equipment, such as range-finders, computers and radar antennas.

NEW OPPORTUNITIES FOR ENGINEERS WITH EXPERIENCE IN THE DEVELOPMENT OF GUIDANCE & FIRE CONTROL SYSTEMS

A new group is now being formed to work on Polaris Missile Sub-Systems at MOSD. It will be located at Pittsfield, Mass. in the heart of the Berkshire resort and vacation area. Openings are at all levels for men with experience in:

GUIDANCE & ELECTRO-MECHANICAL COMPONENTS

Design, evaluation of guidance and fire control equipment

Design, development of electro-mechanical components and servomechanisms

Design, development, evaluation of inertial components, synchros, pick-offs, accelerometers, stable platforms, platform gimbals, verticals, etc.

Design, development, fabrication of analog computers for guidance and fire control systems

GUIDANCE & CONTROL SYSTEMS

Mathematical analysis, feasibility study of control systems and techniques

Synthesis, design, evaluation of guidance and fire control systems

Laboratory development, testing, modification of control systems

ELECTRICAL & ELECTRONIC COMPONENTS

Development of amplifiers and associated circuitry

Development, packing of electronic, magnetic, transistor servo type circuits and components

Reliability, evaluation, analysis of electronic circuits and components

Design, development of fire control consoles

Systems integration, design of electrical and electronic components

Development of electronic and solid state devices, semi-conductors, new transistor applications

OPPORTUNITIES OPEN ON OTHER MISSILE PROGRAMS

Engineers and Scientists with experience in other areas of Electrical Engineering, Aeronautical Engineering, Aerodynamics, Mechanical Engineering, Physics or Mathematics should inquire about positions on other missile programs at Missile and Ordnance Systems Department.

AN INVITATION

If you would like to contribute to any of the advanced missile development programs at MOSD, you are invited to send a resume of your education and experience. Or write us for a convenient application form. All resumes will be carefully reviewed by the MANAGERS of our various technical components. You will be invited to visit our offices and discuss work we are doing directly with the Manager with whom you will be working. Communications will be entirely confidential.

Please send resume to Mr. John Watt, Room 595-9

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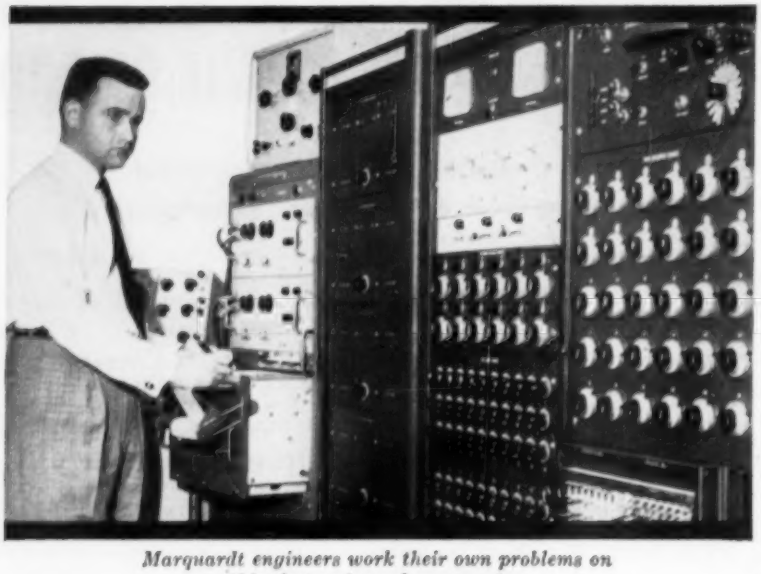

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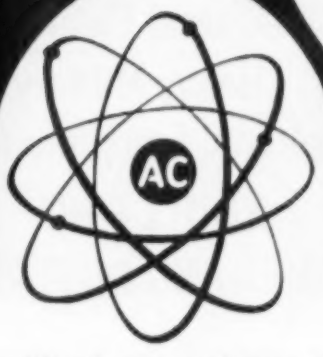

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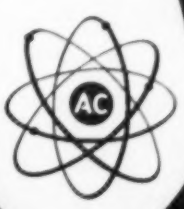

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Conduct operational checks on electronic and electromechanical systems, locate and evaluate deficiencies and report on specific phases of the environmental test program.

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PROJECT ENGINEER — AIRBORNE EQUIPMENT
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RELIABILITY ENGINEER
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OPERATIONAL EVALUATION ENGINEER
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PRODUCTION TEST EQUIPMENT DESIGN ENGINEER
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GYRO DEVELOPMENT ENGINEER
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PLATFORM ENGINEER
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ELECTRO-MECHANICAL ENGINEER
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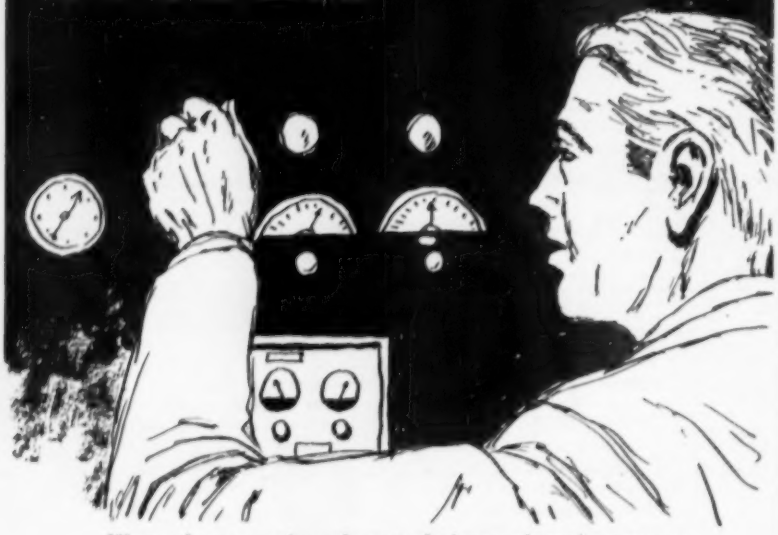

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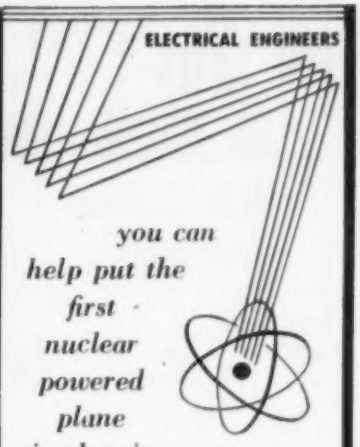

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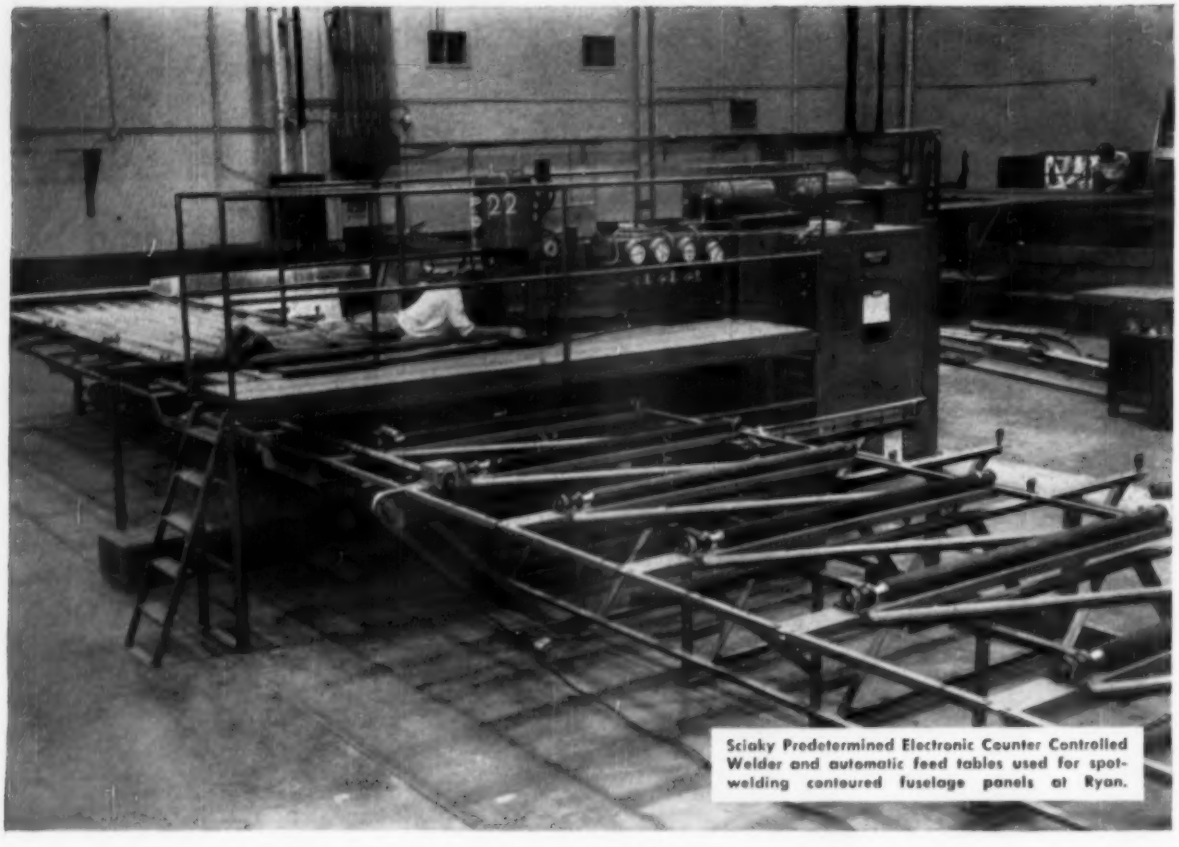

Sciaky Predetermined Electronic Counter Controlled Welder and automatic feed tables used for spot-welding contoured fuselage panels at Ryan.

COMPLEX SPOTWELDING PROGRAM AT RYAN IS SEVERE TEST FOR NEW SCIAKY COUNTER CONTROL

Ryan Aeronautical Company, San Diego, California has achieved a significant first in resistance welding—automatic spot welding of large contoured fuselage panels for the Boeing KC-135 and "707" Jets.

Referring to their new Sciaky Counter Controlled Welder, Mr. Bob Fullerton, Ryan's Senior Welding Engineer, stated, *"This is one new welding development that really does what the advance announcements promised."*

PRECISE CONTROL

Early in the program, it became obvious that precise control of all welder functions and absolute production consistency of welding was essential. Introduction of the new Predetermined Electronic Counter Controlled Welder by Sciaky helped solve this problem.

Here, for the first time, is a welder in which functions are controlled to a fraction of a cycle of alternating current. Control settings are realized with exactness. The unvarying accuracy of counting is maintained throughout the entire range for the longest run at the highest production rate. Any production control setting is readily reproducible at any time.

CONSISTENT, SAFE WELDS

The consistently safe welds produced by the Sciaky Counter Weld Control are essential to the Ryan program since the skin is a load-bearing member. In addition, the size of the assembly—largest every sub-contracted in the industry—will not tolerate even the possibility of rejects due to imperfect welds.

The importance of consistently perfect welds is emphasized by the tremendous number of spotwelds in the aft fuselage sections of the Boeing jet tanker-transports. Approximately 77,000 spot welds are required to join skins to skins, skins to doublers and stringers, and bulkhead components together.

TAPE COMMAND OF WELDING OPERATIONS

Welding operations on the various assemblies can be controlled by a tape command unit providing complete piece part positioning in all directions. Automatic interlock between positioner and welder is required. This would provide more automatic operation.

COMPLEX TOOL-UP

Handling and positioning the aluminum skins also presented a major problem. Ryan solved this by installing huge positioning tables with push button controls to permit automatic feeding.

The characteristics and consistent operation of the Sciaky Counter Controlled Welder combine perfectly with the automatic abilities and consistency of the Ryan positioning table to satisfy the requirements of this complex production assembling operation.

LITERATURE AVAILABLE

Technical bulletins completely describing the new Sciaky Predetermined Electronic Counter Weld Control are available. Write on your company letterhead requesting Bulletins 338 and 339.

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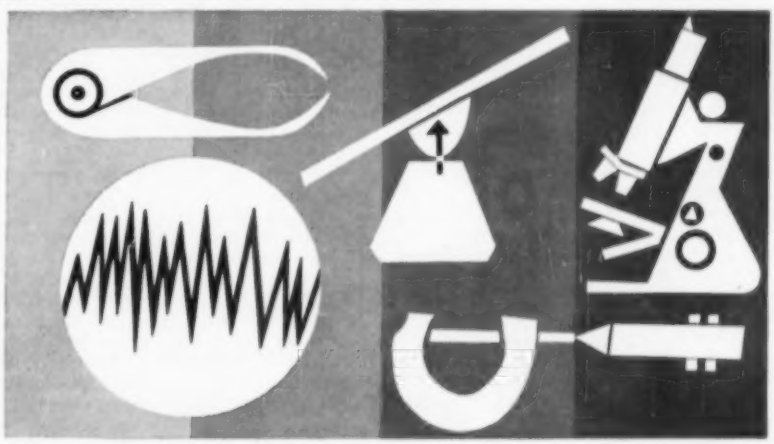

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LETTERS

Timely Leadership

Your recent editorial on airspace, which appeared in AVIATION WEEK's May 27 issue, was a most timely statement of policy. It was specific, objective, and showed great determination and insight into the needs of aviation.

Please accept my congratulations to you and AVIATION WEEK for this continued evidence of leadership in our industry.

MILTON W. ARNOLD
Vice President
Operations & Engineering
Air Transport Association of America
Washington, D. C.

Transport Vision

Your editorial "Transport Cuts Are Dangerous" in the July 8 issue of AVIATION WEEK is as right as gospel. However, few people realize that planning for logistics and material are not an innate quality of the military mind.

The average senior officer who makes policy decisions is a fighter, a tactical man, steeped in the lore and tradition and glory that is a heritage of the military service. He is brave, loyal, patriotic and generally inconsiderate of his own feelings and welfare when it comes to matters which he feels are a part of his military duty. His sterling qualities of honesty, uprightness, fairness and justice set him apart.

With all the final qualities I attribute to the average senior military man, he is not, in general, a good planner for future operations.

He is not out front in the adaptation of technology to prosecute the art and science of war. Witness how many wars are started with equipment and tactics of preceding wars. Look how long it took to get the revolver adapted. We had horses for almost thirty years after mechanization had outmoded them. In 1937 we should have been completely committed to modernization of our armament, but our dear old Frank Andrews was forced to buy outmoded B-18s when B-17s were available, a craft as superior tactically to a B-18 as a C-132 is to a C-54.

All the people who made the decisions which maintained the military equipment in its status quo were honorable men. They conscientiously believed they were making correct decisions for the welfare of their country.

If AVIATION WEEK is dedicated to supporting a continuously efficient military force for our country it will find that best dividends will be obtained by a continuous program of education of the military.

In addition to the development of missiles and ultrasonic manned aircraft, the most important aspect of military power which needs development today is transport aircraft, and the ability to move a potent force to any place in the world within a relatively short space of time, plus the ability to support that force. We could keep regiments of soldiers or marines or police available to move to the Near East, for instance, much more cheaply here at home than we can float them in ships in the Mediterranean. Also, they can fly from Fort Benning to Naples more quickly than they can sail from Gibraltar to Naples and probably more safely.

Not only is there urgent need in the military for efficient air transport, but there is as great a market for commercial air transport in competition with trucks and railroads today as there was for railroads in 1840 in competition with river canals. One day's investment in inventory can be saved by air movement rather than rail or truck movement, for each 1,200 mi. goods are moved.

I hope you don't give up the transport battle.

MAJ. GEN. CLEMENTS MCMULLEN,
USAF (ret.)
San Antonio, Tex.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

ALPA Defends Specht

This is written with further reference to the Specht case (AW March 18, p. 30) which seems to be enjoying quite a stay in your "Letters to the Editor" column.

It is interesting to note that some of the individuals who were willing to condemn Capt. Specht on the basis of brief and unverified newspaper reports are now inquiring as to the facts in the case.

The facts are important to every individual who flies an airplane, who rides in an airplane, or who is interested in fair principles of justice. However, the facts are too complex to be set forth in a letter to the editor or in a newspaper column.

Briefly stated, Capt. Specht was flying on an ATC clearance under conditions which, in his opinion, placed him in an emergency situation. There was one other airplane in his area at the altitude immediately above him. His decision was that to alleviate his emergency, it was necessary for him to climb. He asked ATC for a higher altitude.

ATC would not provide it. He informed ATC that he was going to declare an emergency.

The ATC controllers did absolutely nothing to protect Capt. Specht in his emergency, to warn the aircraft above him or to otherwise perform their required duties under the circumstances. Instead they assumed that Capt. Specht did not have an emergency, failed to carry out their required functions, failed to provide protection to Capt. Specht or the other aircraft concerned, and reported their assumption to a Safety Agent.

The Safety Agent listened to the taped transcript and, without making any further investigation whatsoever, arbitrarily suspended the license of Capt. Specht. There was no investigation and, based entirely on an assumption of what had gone on in Capt. Specht's mind and in his airplane, this action was taken. Capt. Specht was condemned without an investigation, a right to be heard, or a trial. This after more than 15 years of airline flying without any infraction of any regulation or a scratch on an airplane.

The assumption, the representatives of the Administrator allege, was justified from the tone of Capt. Specht's voice. They assert he had no right to be irritated because they left him in an emergency condition with no help whatsoever.

Under our Civil Air Regulations, a pilot has the right, in fact a duty, to declare an emergency and exercise his emergency authority whenever, in his judgment, the facts necessitate it. This Capt. Specht did. The CAA representatives, from the comfort of their offices, would now second guess Capt. Specht's judgment. This, in our opinion, is an irresponsible misuse of statutory authority, especially when added to the failure of CAA to provide for the emergency at the time it existed.

To add further to this comedy of errors by CAA, the Administrator utilized the emergency section of the Civil Aeronautics Act and suspended Capt. Specht's license without an investigation, without a hearing, without charges, without an opportunity to be heard, and without an examination as to his qualifications. If such actions are to be tolerated, it will mean that the Administrator's representatives have arbitrary and unilateral authority to terminate an individual's professional career as a matter of whimsy and, if errors are committed, you, Mr. Airman, will pay the penalty.

The CAA, in my opinion, by its action in this case has created a hazardous condition in aviation. The pilot's right to exercise his emergency authority is one of the greatest protections afforded him and the traveling public. It is the only protection under certain circumstances against inadequate airways systems, inadequate airports, inadequate regulations, personnel errors, and many other foreseen and unforeseen contingencies.

There is no question but what it must be exercised with good judgment. However, if every pilot must feel that each time he exercises his emergency authority he is exposed to having qualified or unqualified representatives of the Administrator irresponsibly and without a fair investigation or a hearing suspend or revoke his pilot's license, either exposing him to exceptional penalties or the termination of his career, there will be an extreme reluctance on the part of pilots to exercise this important prerogative.

A hazard is thereby created.

Your readers should think deeply before they jump to conclusions, condemn people without evidence, or create the aeronautical hazards they seem anxious to avoid.

CLARENCE N. SAYEN, President
Air Line Pilots Association
Chicago, Ill.

American Airlines Orders Turbine Vibration Indicating Systems

Electras and Boeing 707s equipped with new Sperry Systems

When American Airlines takes delivery in 1959 of the first Lockheed Electras and Boeing 707s, these airliners will be equipped with the latest Sperry contribution to efficient operation of prop-jet and turbo-jet aircraft—the new Airborne Turbine Vibration Indicating System.

Measuring vibration in propellers and turbines, an indicator reports continuously to the crew from unique pickups located in strategic powerplant locations. An amplitude meter plus a signal light on the cockpit instrument panel give the crew advance warning if vibration in any of the four turbines or propellers approaches prescribed limits. Corrective action can be taken quickly by reducing speed of the affected engine or shutting it down.

Pay-off is maximum utilization of each turbine's power potential and more precise control of its operation. In addition, there is less chance of engine damage due to vibration, which in turn reduces maintenance and repair costs.

For full details on this new Sperry Vibration Indicating System, and the extra margin of operating efficiency it provides for both prop-jet and turbo-jet aircraft, write our Aeronautical Equipment Division.

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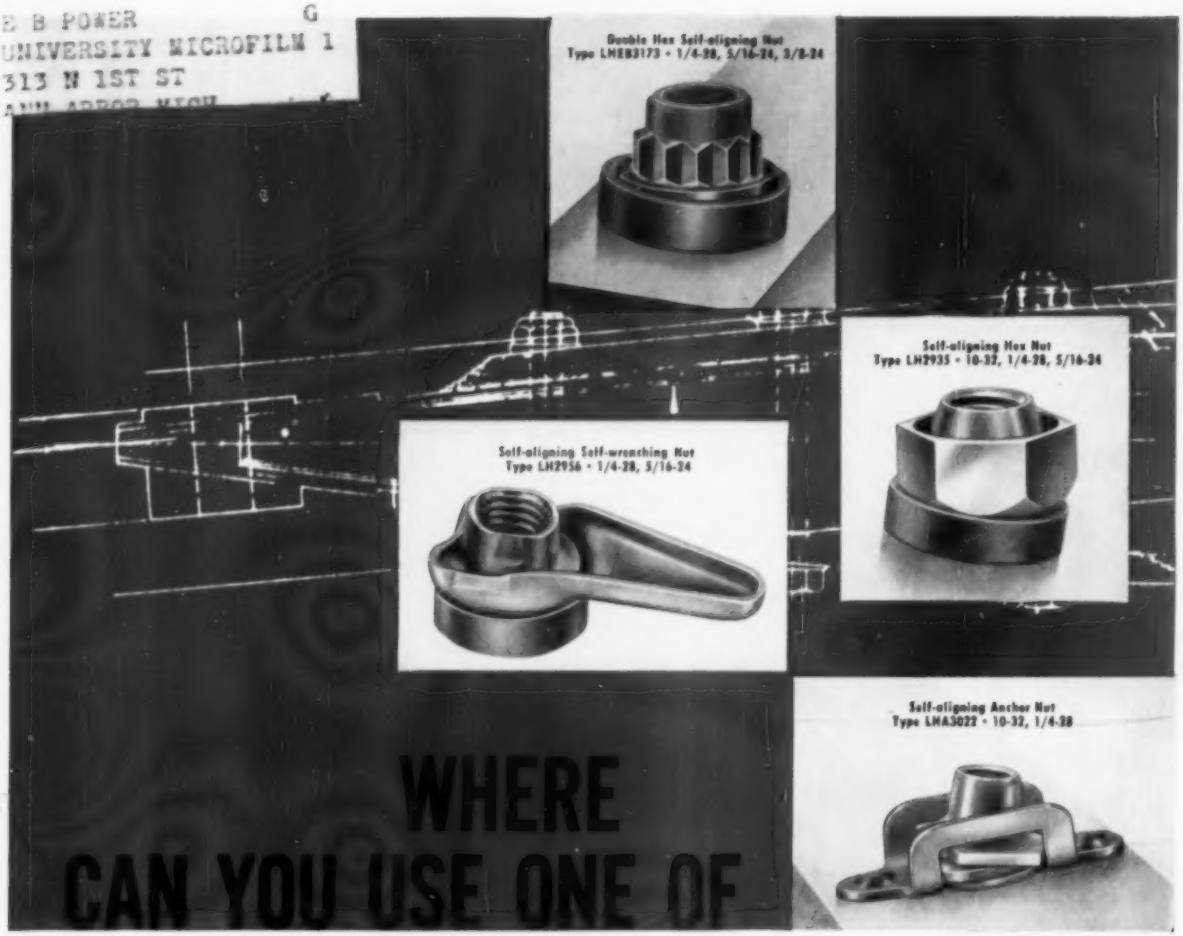
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